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IMPERIAL AGRICULTURAL RESEARCH CONFERENCE, 1927.

Report

and

Summary of Proceedings.

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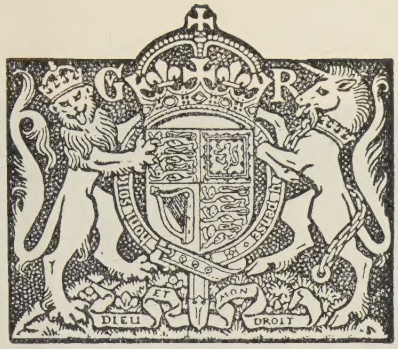

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24—109.

November, 1927.

SIR,

I have the honour to present to you the accompanying report of the first Imperial Agricultural Research Conference, which was initiated and called by your predecessor, and was opened by yourself on the 4th October last.

I have only to add, as Chairman of the Conference, that the representation of every part of the Empire was worthy of the occasion; that the proceedings were directed to subjects of high importance, were relevant, businesslike and harmonious; and that the results attained, which I summarized in my speech at the concluding session of the Conference,* will, in my judgment, be of lasting benefit to every part of the Empire.

I have the honour to be, Sir,

Your obedient Servant,

BLEDISLOE.

Chairman of the
Imperial Agricultural Research Conference, 1927.

Parliamentary Secretary,
Ministry of Agriculture and Fisheries.

The Rt. Hon. WALTER GUINNESS, M.P.,
Minister of Agriculture and Fisheries.

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* See p. 191.

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I. INTRODUCTION.

1.—Origin of Conference.

1. Co-operation in research generally within the Empire has been the subject of consideration for some years past, and a number of agencies have been established with the object of securing such co-operation. Agricultural science has not been omitted; the Royal Botanic Gardens, Kew, and the Imperial Bureaux of Entomology and Mycology are centres for co-operation in their respective subjects. Workers in different branches of agricultural science pay visits from time to time to other parts of the Empire, and the results of their research are to some extent communicated by means of the exchange of publications.

2. The Ministry of Agriculture and Fisheries was, however, convinced some years ago that further steps in the direction of co-operation could not but benefit workers in agricultural science, both in the Mother Country and in the Dominions and Colonies. In 1923, the Ministry accordingly, in conjunction with the Department of Scientific and Industrial Research, submitted to the Imperial Economic Conference a memorandum on the subject. That Conference adopted the following resolution :—

> "The Imperial Economic Conference take note of the memorandum on the co-ordination of research bearing upon industry and the suggestions for its development submitted by the Department of Scientific and Industrial Research in consultation with the Ministry of Agriculture and Fisheries and other Departments, and they are of opinion that all possible steps should be taken to encourage the exchange of scientific and technical information between the various parts of the Empire, and the co-operation of the official and other organizations engaged in research for the solution of problems of common interest."

3. This resolution was communicated by the Colonial Office to the Governments of the Dominions, Colonies, &c., from which were received despatches, indicating the interest generally taken in this matter, and the desire to promote co-operation not only between the Mother Country and the Dominions and Colonies, but also between the Dominions and Colonies themselves.

4. The resolution was also brought before the Agricultural Research Council of Great Britain. At its meeting on the 13th July, 1925, the Council agreed that the time was ripe to take definite steps to secure the co-operation desired. It accordingly recommended that the Ministry of Agriculture and Fisheries be asked to approach the Colonial Office with a view to obtaining lists of the institutions engaged in agricultural research and higher agricultural education throughout the Empire together with the names of

the principal members of the staff and the subjects of research on which they were engaged ; and with a view to seeking the opinions of the various Governments as to the desirability of holding an Imperial Agricultural Research Conference in 1927.

5. Despatches were sent at the end of 1925 by the Dominions, Colonial and India Offices in this sense, and the replies were so satisfactory that the Ministry of Agriculture and Fisheries felt justified in submitting to the Imperial Conference, 1926, a memorandum definitely proposing that a Conference should be held, as was suggested by the Agricultural Research Council.

6. The subjects which it was considered would fall to be discussed at such a Conference were primarily of an administrative character, and would relate to the machinery for securing effective co-operation in agricultural research throughout the Empire. At the same time such a Conference would afford an opportunity for the review by technical workers of the present stage reached in some at least of the different branches of research, and might lead to the formulation of joint programmes of work. Such a Conference could not fail to result in closer co-operation and understanding between workers in agricultural research throughout the Empire and between the officials responsible for its administration.

7. The proposal for an Imperial Agricultural Research Conference was considered by the Research Special Sub-Committee of the Imperial Conference, 1926. It was approved, and the Sub-Committee submitted a resolution in its favour to the Imperial Conference, with certain recommendations as to the scope and purpose of the proposed Conference. The resolution was adopted by the Imperial Conference ; the following are its terms :—

> " The Conference notes with approval the proposal to hold a conference in London in 1927 representative of the organizations of the Empire concerned in agricultural research and its administration, for the purpose of discussing such questions as the extension of co-operation between the organizations ; the promotion of joint programmes of research ; the utilization of the results obtained ; and the training, supply and interchange of scientific workers.
>
> " The Conference urges the respective Governments to give the fullest possible support to the proposed Imperial Agricultural Research Conference."

8. A resolution was also adopted by the Imperial Conference, 1926, approving of the project for fostering a chain of research stations, situated in appropriate centres in tropical and sub-tropical parts of the Empire.

The resolution was in the following terms :—

> " The Conference in particular expresses its cordial approval of the project by the [Empire Marketing] Board of fostering a chain of research stations, situated in appropriate centres in

tropical and sub-tropical parts of the Empire, and commends this project to the sympathetic consideration of Governments, institutions and private benefactors throughout the Empire."

9. In approving of the proposed Imperial Agricultural Research Conference the Imperial Conference Sub-Committee recommended, *inter alia*, that the Ministry of Agriculture and Fisheries in London should be responsible for organizing the Conference; and this responsibility was willingly accepted by the Ministry.

2.—Organization of Conference.

10. In the winter of 1926-27 the Dominions, Colonial, India and Foreign Offices, at the request of the Ministry, notified the various Governments of the Empire of the resolutions and recommendations of the Imperial Conference, 1926, invited those Governments to nominate delegates to the Imperial Agricultural Research Conference, gave an outline of the administrative questions to be discussed, and asked those Governments to communicate particulars of, and memoranda on, the special administrative and technical subjects which they desired placed on the Agenda. At a later date those Governments were also asked to forward general surveys of agricultural research work and problems in their various territories.

11. In February, 1927, the Minister of Agriculture and Fisheries, the Right Hon. Walter Guinness, M.P., appointed an Organizing Committee for the Conference (of which Lord Bledisloe, Parliamentary Secretary to the Ministry, was Chairman), consisting of representatives of Government Departments in the Mother Country and of the Dominions and Colonies: the composition of the Organizing Committee is shown in Appendix A.

12. The Committee were fortunate in securing the permission of the Lord Great Chamberlain to the use of the Grand Committee Room in Westminster Hall, Houses of Parliament, for the Plenary Sessions of the Conference, and in obtaining from His Majesty's Office of Works ample accommodation for the Committees of the Conference. In order that the delegates might be made aware of the progress achieved in agricultural research in the Mother Country since the war, a tour of visits to research institutes in England and Wales, Scotland and Northern Ireland was planned; the arrangements for the tour were facilitated to a remarkable degree by the readiness with which the authorities responsible for the conduct of research into agriculture and allied subjects offered their co-operation. A complete account of these visits will be found in Appendix D, and it will suffice to mention here that the principal centres visited were Cambridge, Billingham, Edinburgh, Aberdeen, Belfast and Oxford. Offers of hospitality were received from Governments, Universities and Civic Authorities in such measure that the Committee were able to arrange a very full programme of entertainment.

13. Acknowledgment must in particular be made to the Government Hospitality Fund, the Board of Agriculture for Scotland, the Government of Northern Ireland, the Universities of Cambridge, Edinburgh, Aberdeen, Belfast and Oxford, the Lord Mayor of London, the Edinburgh Corporation, the Aberdeen Corporation, the Imperial Institute, and Synthetic Ammonia and Nitrates, Ltd. Reference must also be made to the arrangements by the L. and N.E. Railway Company for the comfort of the delegates while travelling, these including the placing of a special train at the disposal of the Conference without extra charge, the provision of meals and co-operation in the provision of a special cinema film exhibit on the train.

14. The Organizing Committee also drew up an Agenda which proved to be substantially that adopted by the Conference: and arranged for the collation of the material forwarded by the different Governments and the preparation of a large number of documents which it was considered would be of value to the Conference in its deliberations. A complete list of these documents will be found in Appendix C. In the preparation of these documents material assistance was derived from the work of previous conferences and committees dealing with various aspects of the subjects under review: in particular the Imperial Conference Research Special Sub-Committee, the Colonial Office (Lovat) Committee on Agricultural Research and Administration in the Non-Self-Governing Dependencies, and the Colonial Office Conference, 1927.

15. As one of the principal objects of the Conference was to enable overseas representatives to familiarize themselves with the agricultural research which is now being carried on in the Mother Country, and to provide a stimulus for the development and co-ordination of agricultural research overseas in the interest of Empire trade and production, the Empire Marketing Board agreed with the Ministry that the cost of the Conference should be met out of the Empire Marketing Fund. An expenditure not exceeding £5,000 was sanctioned from that Fund for the purposes of organization. In the event the whole of this sum did not prove necessary, the total expenditure being well under £3,000. The chief items of expenditure were railway fares, entertainment, hire of chars-à-bancs, printing, stencilling, and reporting.

3.—Business Proceedings.

16. The Conference was opened by the Right Hon. Walter Guinness, M.P., Minister of Agriculture, on 4th October, 1927. Thereafter the Conference appointed the Right Hon. Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture and Fisheries, as Chairman, and the Right Hon. W. G. A. Ormsby-Gore, M.P., Lord Lovat and Major Walter Elliot, M.P., as Vice-Chairmen. The opening speeches of Mr. Guinness and Lord Bledisloe will be found

in Part IV, Sections 1 and 2. The Secretariat of the Conference (and also of the Organizing Committee), under the direction of Mr. W. R. Black, was provided by the Ministry of Agriculture and Fisheries and the Empire Marketing Board. An Executive Committee, consisting of representatives of the Mother Country, Dominions and Colonies was appointed by the Conference.

17. The first act of the Conference was to send the following message of greeting to His Majesty the King :—

> " The Imperial Agricultural Research Conference, at their first meeting, desire to offer to Your Majesty an assurance of their loyal devotion and of their resolve that the present Conference shall be instrumental in promoting friendly co-operation throughout Your Majesty's Empire among all those who are engaged in the advancement of agricultural science and its application to the needs of the agricultural industry."

His Majesty's gracious reply was in the following terms :—

> " I have received your message with great pleasure. Please convey to the Conference an expression of My sincere thanks and of My interest in their work, of which I realise the great importance to the prosperity of all parts of the Empire."

18. For the consideration of the administrative questions on the Agenda, viz., (1) Recruitment, training and interchange of workers, (2) Chain of research stations, (3) Imperial bureaux and interchange of information, the Conference appointed an Administrative Commission under the chairmanship of Lord Bledisloe, which, in turn, appointed a separate committee for each of these three questions with (1) Mr. F. L. Engledow, (2) Major Walter Elliot, M.P., (3) Sir R. B. Greig, as Chairmen.

19. For the consideration of specialist subjects the Conference appointed the following specialist committees :—

A. *Animals.*
- (1) Veterinary Science (Chairman : Sir Arnold Theiler).
- (2) Animal Nutrition (Chairman : Professor T. B. Wood).
- (3) Animal Genetics (Chairman : Dr. F. A. E. Crew).
- (4) Dairying (Chairman : Dr. S. S. Cameron).

B. (5) *Soils and Fertilizers* (Chairman : Sir John Russell).

C. *Plants.*
- (6) Plant Breeding (Chairman : Professor A. E. V. Richardson).
- (7) Plant Pathology (including Mycology) (Chairman : Sir David Prain).
- (8) Fruit (Chairman : Mr. W. T. Macoun).

D. (9) *Entomology* (Chairman : Dr. G. A. K. Marshall).

E. *Economics.*
- (10) Agricultural Economics (including Marketing) (Chairman : Mr. C. S. Orwin).
- (11) Preservation and Transport (Chairman : Mr. H. T. Tizard).

20. The reports of the Commission and Committees in the form in which they were adopted by the Conference are given in Part II of this Report.

4.—Next Meeting of Conference.

21. During the course of the Conference, Mr. G. A. Julius, the head of the Australian Delegation, announced that so strongly did the Government of the Commonwealth of Australia recognize the value of the contact between scientific workers and administrators in agricultural science afforded by such conferences, that his Prime Minister, Mr. Bruce, had cordially invited the Conference, should it decide to meet periodically, to hold its next meeting in Australia.

22. The invitation was very readily accepted by the Conference, which resolved that its next meeting should be in Australia in 1932.

23. Following the acceptance by the Conference of the invitation of the Prime Minister of Australia, a message was transmitted from Mr. Coates, the Prime Minister of New Zealand, by the Hon. Sir James Parr, High Commissioner for New Zealand, extending a cordial invitation to all those delegates who attend the next Conference, afterwards to visit New Zealand, where they will receive a hearty welcome. Mr. Coates also stated that the New Zealand Government would co-operate with the Government of the Commonwealth of Australia with a view to assisting in making the next Conference in every way valuable and successful.

24. Mr. Coates' cordial invitation was received with great pleasure by the Conference, and Lord Bledisloe, in replying to the invitation, stated that he was sure that as many as possible of the delegates to the next Conference would be most happy to include New Zealand in their itinerary.

25. At the concluding session Mr. Julius asked that all those concerned in the present Conference should consider whether they could make suggestions which would lead to the work of the next conference being of even greater value than that of the present one. It was promised, on behalf of the Ministry of Agriculture, that that Department would be delighted to receive and to record suggestions which may be made between the present and the next conference, and to take any steps within its power to ensure that the next conference would be a worthy successor to the present one. Such suggestions should accordingly be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

---

26. Certain prominent members of the Conference have expressed the view that the Conference's Report could have no better preface than a reprint of the brief but most illuminating introduction written by the Earl of Balfour for the Report of the Research Sub-Committee of the Imperial Conference, 1926. That introduction is accordingly reprinted immediately below as the preface to the Report.

II. REPORT OF CONFERENCE.

1.—Preface.*

The material well-being of mankind may be diminished by many causes—e.g., international wars, domestic disorder, industrial disputes—but (if individual effort remain on the average unchanged) there are only two causes which can increase it—namely, better natural sources of supply, and better methods of turning these sources to account. If we are to rely (as we increasingly must) on the second of these causes of economic progress, it is to applied science that we must turn for aid.

But, granting this to be true, how, it may be asked, does the fact concern the Imperial Conference ?

It concerns the Imperial Conference because we are here touching on interests that are more than regional. The Empire includes States and territories of the most varied economic capacity ; possessing every gradation of climate and soil, every species of mineral wealth, subject in parts to special diseases, with which only science can hope to deal ; enjoying in parts unique natural advantages which only science can fully develop. It possesses distinguished investigators in every branch of research. It has, therefore, everything to gain from full scientific co-operation, yet we can hardly flatter ourselves that we practise this, either within Great Britain or throughout the Empire. Here, surely, we find ourselves face to face with a situation in which the free discussions of the Conference may give us priceless aid.

But what, it may be asked, can such discussions really accomplish ? Doubtless the relations between science, industry, and departmental administration are far from easy ; but would they not become wholly impossible if even the faintest attempt were made to improve them through any form of Imperial control ? They certainly would ; and it is not in this direction that better co-operation is to be looked for.

Again, can we suppose that either money or organization can increase the supply of original scientific genius, or direct it, when found, into utilitarian channels ? It is plainly impossible. Genius cannot be made to order, nor discovered by rule. The best we can do is to provide fitting opportunities for its exercise when we are fortunate enough to find it.

These may seem to be discouraging reflections ; yet I am convinced that much may be accomplished if we are not too ambitious. To make the position clear let me roughly sketch the four stages

* Introduction to the Report of the Research Special Sub-Committee of the Imperial Conference, 1926. (By the Right Hon. the Earl of Balfour, K.G., O.M., F.R.S., Lord President of the Council and Chairman of the Research Special Sub-Committee.)

into which we may ideally divide the re-actions of science on particular industries.

They begin with the fundamental discoveries in pure science on which all subsequent progress depends. These have commonly been made with no thought of any useful application, and are due to the love of knowledge alone.

The second stage is reached when it occurs to some man of science that these fundamental discoveries may be employed in the solution of a practical problem which has been engaging his attention.

The third stage (which is closely associated with the second) consists in exploring the full significance and value of this conjecture by means of small scale experiments, while

The fourth consists in the application of the knowledge thus obtained to the business of economic production.

Such in bare outline seems to be the normal movement from fundamental discoveries to the most advanced enterprises of the agriculturist and the manufacturer. In historic fact it is often a very long and very elaborate journey, filled with dramatic complications, sometimes even with dramatic tragedies. About these we are not concerned ; for it is on the two middle stages of the process that the efforts of organized research are chiefly concentrated ; and we may almost say that their principal aim is to shorten and cheapen the passage which separates pure scientific theory from pure industrial practice.

There are at this moment in different parts of the Empire a large and increasing number of Institutions devoted to this purpose, and the work they are individually doing is admirable in quality, and as large in quantity as their financial resources permit.

How then is it possible for the Conference to assist ? It cannot give money ; it cannot impose a policy. The greatest service it can render (and it may be no small one) is to encourage those States of the Empire which are interested in research to consider sympathetically the suggestions contained in this Report. Those who do so will probably agree with the conclusions I have already ventured to indicate. Let us cultivate easy intercourse, and full co-operation will follow. Investigators in the same intellectual field, though far separated in space, will work as partners. Overlapping, and all the intellectual waste that so often accompanies overlapping, will be greatly diminished ; and considered judgments about the gaps in our knowledge which most urgently require to be filled will follow as of course.

2.—Proposed Chain of Tropical and Sub-Tropical Research Stations.

1. The Conference have considered the memorandum* submitted to them on the subject of the proposed chain of tropical and sub-

* Appendix B., p. 220.

tropical research stations, and find themselves in cordial general agreement with the scheme which it outlines. They have discussed certain aspects of that scheme and record their conclusions in the following paragraphs.

2. *Functions and Location of Stations.*—They consider :—

(i) that the establishment of central tropical and sub-tropical research stations should be governed primarily by the ascertained needs of Empire research in particular fields of agriculture, rather than by considerations of geographical distribution.

(ii) that stations for dealing with problems suitable for such treatment should be located in territories affording specially advantageous conditions for the study of each such problem.

(iii) that the stations should, in the main, confine themselves to " long range " and " wide range " research, i.e., that they should concentrate on (*a*) problems requiring more prolonged research work than can normally be expected from the technical staff of any single administrative department ; (*b*) problems arising in more than one territory of the Empire towards the solution of which the comparative method may be expected to make an effective contribution.

3. *Relations with Agricultural Departments.*—The Conference desire to emphasize the importance of preventing the establishment of a central research station from being allowed to impair or replace the scientific work properly undertaken by the Agricultural Department of any Government in its proximity. They conceive the work of such stations as a reinforcement of that of the Agricultural Departments, and in no sense as a substitute for their work. The work undertaken by a central research station will from time to time enable it to afford valuable advice to Agricultural Departments in its neighbourhood, but they do not consider that it should be regarded as a function of a central station as such to provide such advice, except as the direct result of its research activities. This conclusion, however, should not be taken as debarring a central station, in special conditions such as those of the West Indies, from being treated as a convenient base of operations for a travelling advisory staff.

4. *Instructional Work by Station.*—The Conference do not consider that a research station, as such, should be expected to undertake any teaching work, except in so far as the advanced instruction of a limited number of post-graduate students can be undertaken with advantage to the research work in progress. In making this recommendation they do not overlook the need, in certain parts of the Empire, and notably in West Africa, for the provision of additional teaching facilities, designed primarily to enable native students to

become qualified assistants in research work, whether at a central research station or in an Agricultural Department, but they consider such provision to fall within the sphere of other Government services.

5. *Staff of Central Research Station.*—The Conference have considered how far any common scale can be laid down for the staffing and financing of a central research station. As concerns staff, having regard to the need for securing continuity, especially in the case of stations where climatic conditions may be unfavourable, the Conference consider that each department of a central research station should be manned by not less than two first-rate workers. They consider it probable that a total superior staff of some ten highly qualified men will prove to be the minimum staff of such a station.

6. *Finance.*—The Conference had before them information as to the existing and prospective costs of research stations in some degree comparable with those projected, and were led by that evidence to suppose that a substantial annual maintenance expenditure will be necessary in the case of every such station. The sum of £20,000 per annum has been mentioned, but the Conference realize that conditions vary so widely as to make it inadvisable to suggest that this figure could be more than an indication of the order of expenditure which they have in mind. They note that adequate capital expenditure must also be envisaged in the case of every such station, and that during at least the earlier years of the existence of any such stations new capital needs would almost certainly disclose themselves periodically. If the establishment of any proposed station cannot be approached with a reasonable confidence that these minimum requirements of staff and finance will be forthcoming, the Conference believe that it should be postponed.

7. *Assistance in Kind.*—The Conference note that contributions towards the establishment and upkeep of a central research station, apart from special endowments and contributions in money, might reasonably include :—

(*a*) Gifts of land ;

(*b*) The placing of neighbouring estates at the partial disposition of the research station for experimental purposes ;

(*c*) Gifts in kind, e.g., machinery, stock, scientific apparatus, &c.

They attach great importance to enlisting the support of agriculturists and agricultural corporations (including stock-raising interests) in the territory in which the station is to be situated, and note that this might be engaged by contributions in one or more of the special forms indicated above.

8. *Possible Sources of Money Contributions.*—The Conference consider that contributions towards the establishment and

maintenance of central research stations might be expected to be forthcoming from :—

(*a*) Central funds, as foreshadowed in recent negotiations between the Empire Marketing Board and the Colonial Office ;

(*b*) Overseas Governments of the Empire whose territories adjoined the station or who were interested in the special problems to which the work of the station was addressed ;

(*c*) Institutions, such as universities ;

(*d*) Public corporations and private companies ;

(*e*) Private benefactors.

9. *Control of Central Stations.*—The Conference consider that no general rule can be laid down as to the form of control most appropriate for a central research station. They confine themselves to expressing the opinion that the control of the station should be so vested as to ensure that the work of the institution should not be diverted from a programme of free research. They recognize that the control of any station established in a self-governing Dominion, or in India, must be the affair of the Overseas Government concerned. In the case of stations established in the Colonial Empire they anticipate that the proposed Colonial Agricultural Research Council will concern itself to secure the general conditions which they have indicated. In their consideration, however, of this subject they have had before them valuable information as to the arrangements made in different parts of the Empire for dealing with problems presenting somewhat similar features. They summarize that information in Appendix E to this Report. They have noted with special interest the arrangements contemplated in the case of the Australian station, referred to below, which, while providing for its control by the Commonwealth Government, provide also for the appointment to its governing body of at least one member designated to represent the other Governments of the Empire.

10. *Programme for Establishment of Stations.*—The Conference have considered the programme for the establishment of central research stations indicated in the Memorandum submitted to them, and reprinted in Appendix B. They consider it to be of the greatest advantage that a provisional programme should be before the Empire Governments, though they believe that its realization must inevitably be gradual, owing in particular to the shortage of fully-qualified research workers available for the staffing of stations of this kind.

11. *Interest of Dominions in Scheme.*—So large a part of the tropical and sub-tropical areas of the British Empire lies within the Colonial Empire, that a majority of the stations proposed must eventually be looked for in Colonial territories. The Conference, therefore, particularly welcome the spontaneous approval of the

scheme by representatives of the self-governing parts of the Empire. They note with lively satisfaction the definite plan for the establishment of a station in Northern Queensland now in preparation by the Commonwealth Government of Australia. They welcome the assurances of interest in the scheme given to the Conference by representatives of New Zealand, of the Union of South Africa, and of India.

12. The Conference recognize that any extension of the programme to include further stations in the self-governing parts of the Empire must be a matter for further consideration by the Governments concerned. They recognize also that, in so far as the programme contemplates the establishment of stations in the Colonial Empire, its development or modification should rest primarily with the proposed Colonial Agricultural Research Council. In general, therefore, they desire to confine themselves to welcoming the authoritative endorsement given to the scheme by the Imperial Conference of 1926 and the Colonial Office Conference of 1927. They believe, however, that they may properly draw attention to two points which have emerged during their discussions of the subject, the first of which is considered in paragraphs 13 to 15, and the second in paragraph 16.

13. *Stations for Animal Diseases Research.*—The establishment of a central research station in connection with the diseases of animals is a matter of great importance, but is attended by special difficulties. There is no doubt that such an institution, if established and conducted on sound principles, could be of immense value in the economical and effective solution of the many problems which affect the successful raising of livestock. A very considerable capital sum would, however, be required for the establishment of such a station, and a large amount for its annual maintenance. Having regard to the general principles of responsibility and control which the Conference consider applicable to the financing and administration of central research stations, there can be no question but that any Government within whose territory such a station might be located would have to undertake very heavy financial and administrative responsibilities. The problem may thus prove so difficult as to lead to an indefinite delay of its solution. The Conference, therefore, suggest as a practical measure that the possibility of utilizing at the outset some existing station for the desired purpose should be seriously considered. The Conference, however, consider that the subject in question is so large that the establishment of another centre, or centres, to deal with it will be not only desirable but inevitable.

14. *South African Station.*—The views expressed in Memoranda submitted to the Conference lead to the presumption that such an expansion of functions might with advantage be applied to the South African Research Station at Onderstepoort. The scientific

reputation which Onderstepoort has gained would ensure confidence in its work from the outset, while the scale of its existing facilities in the shape of staff, accommodation, equipment and other essentials, places it in a most favourable position to undertake an immediate expansion of the scope of its work. The additional expenditure involved would not only be relatively insignificant as compared with the cost of a new station, but would in fact seem certain to entail a very small additional annual charge.

15. Administrative difficulties would no doubt have to be surmounted before effect could be given to this proposal. But the Conference believe that if the Governments concerned were consenting parties to the proposal a ready and satisfactory solution of those difficulties would be found.

16. *Station for Irrigation Research.*—The second subject upon which the Conference desire to make a definite recommendation is that of irrigation. They have been impressed by the desirability of further exploration of the need for a central research station to deal with problems of irrigation, and they recommend that this apparent need should be brought to the notice of the Lord President of the Council with a view to the appointment of a Sub-Committee of the Committee of Civil Research to investigate and report upon it, including its engineering, medical, agricultural, chemical and physical aspects. Copies of any Report issued by such a body would be of great interest to the Governments of the Empire. The Conference note with interest the research work on this subject at present in progress in the Punjab and in the Sudan, and appreciate as an immediately practical contribution the offer made by these Governments of facilities for workers from any part of the Empire.

3.—Bureaux and Interchange of Information.

17. The Conference considered how best to establish and develop effective clearing houses for the interchange of information of value to research workers in agricultural science throughout the Empire.

18. *Functions of Clearing Station.*—The functions of an Imperial Clearing Station should be to collect, collate and disseminate information of a scientific and technical character; to reply to enquiries on scientific and technical problems from agricultural departments and scientific workers in any part of the Empire; and particularly to facilitate intercourse among groups of workers on closely allied problems.

19. The Conference gave careful consideration also to the question of the establishment as part of the Imperial Bureau organization of additional laboratories for attacking Imperial problems, but are of the opinion that it is not desirable that such action should be taken at present.

20. *Location of Clearing Station.*—As an Imperial Clearing Station will collect and disseminate information, the most suitable location

will doubtless be where a body of information, a staff of workers, and the necessary scientific atmosphere already exist, i.e., in proximity to or in connection with an existing research institution. The simplest and most economical method of establishing a station is, therefore, so to add to the staff of an existing research institution as to enable it to undertake the additional duties imposed on it. On general principles the Conference recommend the establishment of Imperial Clearing Stations in small numbers, and on a modest scale, as they believe that it is only through experience and by a process of "trial and error" that the best results will eventually be attained.

21. The Conference were impressed by the representations made to them in favour of Imperial Clearing Stations of a comprehensive character for the subjects of Soil Science, Animal Nutrition and Animal Health, and are of opinion that the number of workers and the output of literature throughout the Empire on these subjects justify the establishment of Imperial Clearing Stations on the scale of bureaux. The scale and location of these Imperial bureaux have been considered by the specialist committees of the Conference,* and in making the following recommendations the Conference have taken their views into account.

22. *Bureaux Recommended.*—The Conference therefore recommend the establishment of the following Imperial bureaux :—

(*a*) An Imperial Bureau of Soil Science attached to the Rothamsted Experimental Station.

(*b*) An Imperial Bureau of Animal Nutrition attached to the Rowett Research Institute, Aberdeen.

(*c*) An Imperial Bureau of Animal Health, London.

The importance of interchange of information on Animal Health is so great that the Conference recommend the immediate establishment in London of an Imperial bureau to deal with problems of animal health, which will include and absorb the section dealing with tropical animal diseases now comprised in the Bureau of Hygiene and Tropical Diseases. The facilities available at the British Museum (Natural History Section) should be kept in mind in establishing the Imperial Bureau of Animal Health, especially in view of the fruitful and close association of the Imperial Bureaux of Entomology and Mycology with these facilities.

23. *Correspondence Centres Recommended.*—In addition to these bureaux, the Conference recommend that Imperial clearing stations of information should be established for the following subjects, but on a smaller scale than in the case of the bureaux suggested above. For convenience, these might be termed Imperial correspondence

* See Sections 5 to 17 of this Report : pages 30 to 58.

centres, and it is recommended that they should be established at the following places :—

(*a*) Animal Genetics ...	Animal Breeding Research Department, Edinburgh University.
(*b*) Agricultural Parasitology*	Institute of Agricultural Parasitology, London School of Hygiene and Tropical Medicine.
(*c*) Plant Genetics ...	Plant Breeding Institute, Cambridge University : to deal with all crops of temperate and tropical regions, except herbage plants. Welsh Plant Breeding Station, Aberystwyth : to deal with herbage plants.
(*d*) Fruit Production	East Malling Research Station, East Malling, Kent.

24. *Correspondence Centre for Fruit Production.*—The Conference have not accepted the recommendation in their Fruit Committee's Report for an Imperial Horticultural Committee. They consider that an Imperial correspondence centre for fruit production problems will be useful for various Dominions and Colonies. Research on these problems is carried out in the Mother Country both at the East Malling and Long Ashton Stations, but since Dominions and Colonies are all materially interested in rootstocks work, the Conference consider that the Imperial correspondence centre for fruit should be located at the East Malling Research Station.

25. *Subjects not dealt with : Economic Botany.*—The Conference consider that the time is not ripe for Imperial correspondence centres or bureaux in dairying, economics, or preservation and transport, or in any of the subjects not dealt with under the recommendations above, as these subjects are not yet sufficiently defined. In particular, in view of the fact that separate Imperial correspondence centres have been recommended for Plant Genetics and Fruit Production, and that the Imperial Institute carries out work with reference to animal and plant products, the Conference do not consider that a separate Imperial correspondence centre for Economic Botany is necessary, but they recommend that the Imperial Institute and the Royal Botanic Gardens, Kew, should continue the useful work they are doing in this connection.

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* With regard to Agricultural Parasitology, although no recommendation was made by a Specialist Committee that an Imperial bureau or correspondence station should be established in that subject, the Conference feel that some organization is necessary for facilitating intercourse among soil, animal and plant workers in that subject in all parts of the Empire.

26. *Dairying.*—The Specialist Committee of the Conference on Dairying recommended the formation of an Empire Dairy Research Committee for the purpose of mutual assistance in the sphere of dairy research, including the exploration of the best means of securing systematic collection and dissemination of information and the publication of an Empire Journal on dairying research. The Conference consider that it might be desirable to give effect to the latter part of this recommendation pending the establishment of an Imperial correspondence centre in dairying.

27. *Preservation and Transport.*—The Specialist Committee of the Conference on Preservation and Transport advised that some machinery be set up at the Low Temperature Research Station for the interchange of lists of new and useful publications. The Conference consider that it would be desirable for the Low Temperature Research Station to undertake that duty.

28. *Single Publicity Bureau.*—The Conference have carefully considered the memorandum submitted by one of the Overseas Governments on the establishment of a single Imperial Publicity Bureau. The Conference are unable to recommend the establishment of such a bureau, as they consider that the interchange of information in a number of highly specialist subjects cannot be efficiently carried out by any single organization.

29. *Financial Supervisory Body.*—The funds which may be made available for the establishment and development of these new Imperial bureaux and correspondence centres should be administered by an Authority representative of the contributing Governments. The Conference recommend that this Authority or financial supervisory body should consist of representatives of the Governments of Canada, Australia, New Zealand, the Union of South Africa, the Irish Free State, India, the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland, the Ministry of Agriculture for Northern Ireland, the Colonial Office, and other contributing Governments.

30. *Technical Committee.*—Each Imperial bureau should be advised by a Technical Committee of Experts (including overseas experts) nominated by the Governments concerned, who should report to the financial supervisory body mentioned above. Imperial correspondence centres should, as far as practicable, also be conducted on the lines suggested above for an Imperial bureau; the actual arrangements should be worked out in the case of each centre with due regard to the desires of the responsible technical workers concerned.

31. *Progress Reports.*—The Conference, realizing the advantages which will accrue to the individual research worker by frequent communication with the Imperial clearing station in the normal course, do not make any specific recommendation for the supply

to the Imperial bureau or correspondence centre of progress reports or reports on unpublished work at regular intervals.

32. *Uniformity in Work.*—The Conference desire to emphasize the convenience and economy of securing uniformity in the size of publications, and methods of printing and presenting data and diagrams, and they, therefore, suggest that if and when the organization recommended above is completed, a meeting of the Directors and others interested should be held to discuss methods of indexing, recording and uniformity of publication.

33. *Central Clearing Station.*—The Conference have considered the question of the establishment of a Central Clearing Station for the collection and distribution of information in regard to agricultural research work over and above what would normally be collected in the proposed Imperial bureaux and correspondence centres. They do not recommend the establishment of such a station. They would prefer to await the normal growth of the sub-divisions of agricultural research to the point when additional Imperial clearing stations could be fully justified for each sub-division.

34. *Imperial Institute.*—The Conference recognize the usefulness and potentialities of the Imperial Institute, and they recommend that the Institute should continue its present valuable work of dealing with raw materials of plant and animal origin, and of forwarding any general inquiries that may reach them to the appropriate authorities. They welcome the Committees which have been set up to deal with plant and animal fibres and they recognize the value of the Bulletin of the Institute and the list of publications which it contains.

35. *List of Agricultural Research Workers.*—In connection with the interchange of information the Conference consider that the "List of Agricultural Research Workers in the Empire," prepared for the present Conference, is valuable and they recommend that it should be revised and periodically circulated.

36. *Survey of Agricultural Research in the Empire.*—The Conference consider that the volume prepared for the present Conference on Agricultural Research throughout the Empire provides a useful general survey, but they think there is hardly need for its annual publication. It should, however, be revised on the occasion of, and for submission to, the next Imperial Agricultural Research Conference.

37. *Periodical Conferences.*—There is no room for doubt as to the value of periodical conferences of research workers. The Conference has itself arranged to meet again in five years' time in Australia. Specialist and regional conferences are desirable, in particular those which ensure a large attendance of actual research workers, but the Conference consider that the initiative in convening these conferences should be left to the authorities most concerned with the immediate problems.

38. *Finance.*—With regard to finance, the Conference recognize that the fulfilment of the programme outlined above will be considered by the Finance Departments of the contributing Governments. With the information before them, they consider that £13,000 for Imperial bureaux and £7,000 for Imperial correspondence centres in all, per annum, guaranteed in the first instance for five years, will be sufficient to meet adequately the immediate needs of the interchange of information between agricultural research workers throughout the Empire.

39. *Procedure in establishing Clearing Stations.*—When the assent of the respective Governments has been signified and funds made available the Financial Committee referred to above should be summoned by the Secretary of State for Dominion Affairs, should call for detailed proposals from the organizations here mentioned, and should thereupon proceed with the programme above indicated.

[*Note.*—When enquiries are addressed to an Imperial bureau or correspondence centre from private corporations or individuals operating overseas it should communicate a copy of the answer to the Agricultural Department of the Dominion, Colony, &c., with which the enquiry is concerned.]

4.—Recruitment, Training and Interchange of Workers.

40. While of great ultimate importance, recruitment and training are also matters of urgency. So far as the Colonial Empire is concerned the dearth of recruits makes immediate reinforcement of activity in recruitment and training essential. The Conference have, therefore, found it necessary to consider not only broad principles, but the detail of their application.

41. *Scholarships in Veterinary Science.*—Education in Veterinary Science was omitted from consideration for the reason that it is under consideration by other specially appointed Committees, but it is desired to draw attention to the importance of providing for veterinary scholarships. There is a grave shortage of candidates for veterinary research appointments in Great Britain, in India, and in the Colonial Empire. The Conference, therefore, urge that immediate attention be given to an extension of the present provision for scholarships in veterinary science.

42. Agricultural improvement—the promotion of the production of wealth from crops and stock—is the objective of an Agricultural Service. To this objective recruitment and training must be strictly related. As in agricultural improvement practice and science go hand in hand, so in framing schemes for recruitment and training, it appears very undesirable to try to separate them. Accordingly in the proposals which follow, consideration is given concurrently to the general agricultural or administrative and to the research or specialist officer. For these two the terms " agricultural officer "

and " specialist officer " will be used.* When it becomes necessary for any purpose to discriminate between these designations, a knowledge of the duties required of the officers in the territory concerned will supply appropriate definitions.

43. In a later paragraph (No. 81) the belief is expressed that no scheme of recruitment and training on an Imperial basis would at present prove practicable. For this reason consideration of qualifications, training, scholarships, and cognate matters (Sections I to IV) has been primarily based upon the circumstances of the non-self-governing Dependencies regarded as a unit. The subjects of Sections V, VI and VII are dealt with from the point of view of the Empire as a whole.

44. The paragraphs which follow are :—

Part A.

I. The Standards and Requirements of a Colonial Agricultural Service.
II. Recruitment for a Colonial Agricultural Service.
III. The Colonial Office Agricultural Scholarship Scheme.
IV. The Training of Colonial Office Agricultural Scholars.

Part B.

V. An Imperial Basis for Recruitment and Training.
VI. Study Leave.
VII. Interchange of Workers.

Part A.

I. The Standards and Requirements of a Colonial Agricultural Service.

45. The Research Special Sub-Committee of the Imperial Conference, 1926, emphatically expressed the view that every effort should be made to attract candidates of the highest class and to equip them with the best possible training. To employ men of inferior calibre would result in waste of opportunity, time and money. This view accords so well with the requirements of an agricultural service that the Conference wish specifically and most strongly to re-affirm it. A high standard is no less requisite in the agricultural officer than in the specialist officer. Different qualifications appertain to the two types of officer, and it is necessary to attempt to specify them. Rigid specification would be unwise. In the Universities and Colleges formal academic qualifications vary widely. Again, experience has shown that a very competent officer may reach his field of successful activity by a devious and

**Note.*—Specialist Officer implies the research, technical or specialist officer : Agricultural Officer implies the general or administrative agricultural officer. The Conference recommend these terms as distinctive and yet not contentious.

often accidental route. A common sense flexibility must, therefore, mark specifications of standard. Character and health are of first importance, and the selecting body must be trusted to give them due weight. An upbringing in rural surroundings, while not essential, is in general a desirable qualification for agricultural officers.

46. (*a*) *The Specialist Officer.*—A sound training in the pure sciences is essential for a specialist officer. While it would be unwise to specify suitable combinations of the sciences, it appears essential to insist on the importance of at least one biological subject. Even in this, rigidity must be avoided. Thus, a man who had read Chemistry, Physics, and Mathematics at the University should not necessarily be debarred. It should be ensured, however, that in his post-graduate training prominence be given to the one or more biological subjects appropriate to the field of investigation he sought to enter. Broadly, then, a training in the pure sciences of University honours standard is the first requirement for the specialist officer. Only in very exceptional circumstances should this requirement be set aside.

47. A knowledge of agriculture is also a requirement. It is a vital requirement. Perfunctory attendance at lectures and practical instruction in such measure as to ensure success in an examination is insufficient. For the specialist officer agricultural knowledge must be sufficient and of such a kind as to enable him to appreciate clearly the role of science in agriculture. It must generate in him an enthusiasm for "practice with science." Thus, for instance, the properly equipped mycologist should be able so to order his work as to render the territory for which he is responsible, the best mycological service. He should be, not only the specialist investigator, but also the trusted mycological adviser of his Director of Agriculture.

48. To couple refined science with sound appreciation of practice is not easy. The ideal standard which has been depicted must not be observed with such rigidity as to exclude altogether the very highly specialized scientist. Particularly in the new central research stations there will be increasing need for men of this type. That rare gift the *flair* for research must, if evident, be set at a high value. Nevertheless, the two-fold standard must necessarily apply so widely in the Colonial Empire that it should be adopted as the working standard.

49. (*b*) *The Agricultural Officer.*—Sound practical knowledge, a practical outlook, and administrative ability, constitute the first requirement. The acceptation of practical knowledge and outlook must not be narrow. An acquaintance with practice of a special or local form without an appreciation of the fundamentals of practice falls below the desired standard. Practice varies so widely between country and country, as for instance England with its plough and

Nigeria with its hand implements, that only an understanding of fundamentals can give the agricultural officer that adaptability which success demands. National aspects, territorial policy, and the economics of raising crops and stock are inseparable from his work. Knowledge and understanding in these things must therefore be counted an important requirement. Finally, scientific training is indispensable. It must be of such an order as will enable—indeed impel—the agricultural officer to regard the practices of his territory from a scientific point of view, to apply as fully as is practicable the established results of agricultural science, and to co-operate with his technical colleagues. Broadly, then, the standard is that of a University degree in agriculture suitably supplemented by post-graduate training.

50. For the agricultural officer in particular, personality is important. Like the specialist officer he should possess the qualities which make an acceptable colleague and a loyal subordinate. He must, moreover, "be endowed by his general education and upbringing with the tact and administrative ability necessary for dealing with the native mind" (Colonial Office Miscellaneous Publication No. 280, p. 6).

II. Recruitment for a Colonial Agricultural Service.

51. The preceding paragraph points to the conclusion that the Universities and Agricultural Colleges are the natural recruiting ground. The available material comprises the suitably trained graduates in pure science or in agriculture, who possess physique and character, and a taste for life overseas. For some years past there has been a deficiency of recruits, and expansion of the Service will intensify this deficiency unless energetic measures are taken. There appear to be three main factors inducing the deficiency. Hitherto the prospects of the posts in the Service have not been uniformly good; but the attractions and nature of the Service are not sufficiently widely known; in the Universities generally, the biological schools lack the numerical strength of the physical science schools. The possible steps suggested by a consideration of these factors are:—

52. *Provision of adequate emoluments and improvement of Service.*—In some Dependencies the Agricultural Service is monetarily inferior to services no more arduous and calling for no higher training. A unified Colonial Agricultural Service would bring many advantages, especially if it enhanced the prospect of promotion and secured good and uniform provident or superannuation benefits. While it has not been possible to propose immediate steps in connection with superannuation, it is desired to urge very strongly the all-round importance of a simple, generous, and unified system for the Dependencies as a whole.

53. *Provision of better technical facilities and opportunities for study-leave.*—It has too often been a just complaint that apparatus

and other facilities for investigation have been entirely inadequate. This fact, coming to the knowledge of the science student—the possible recruit—may have a strong deterrent effect. For the sake of the Service research facilities should be good, and good facilities would aid recruitment of technical officers.

54. *Information about the Service.*—Information must be made readily available; indeed, it must be brought under notice in the Schools and the Universities. Formal statements alone will not suffice. First-hand knowledge must be made available by lectures and by suitable writings in reviews and other publications. Tutors, lecturers, and others in advising undergraduates about their careers, are often hampered by lack of knowledge. Enquiries are naturally made about climate, amenities, mode of life, and official duties. It would be extremely helpful if a series of short pamphlets could be written preferably by serving officers. These, in our schools and Universities, would guide the tutor and arouse public interest.

55. In the past demands for men have reached the Universities in a very irregular stream, fluctuating sharply from year to year, and bearing no relation to the flow of available men. A means must be devised to enable the Colonial Office to present its demands with greater regularity. Sharp fluctuations in demand arouse in the minds of tutors, parents and undergraduates an uncertainty which militates strongly against recruitment.

56. *School Scholarships.*—Two separate forms have to be considered. The first is the scholarship awarded to the boy at school to enable and induce him, while still at school, to direct his studies along approved lines. It might, for example, be a condition of award that he studied one or more biological subjects. That he should be prepared to accept in due time a scholarship to the University to pursue there a prescribed course, might be another condition. This first possible form of School Scholarship appears undesirable on all grounds. Anything approaching premature specialization is abhorrent to the spirit of true scholarship and would find no favour with the Schools and Universities.

57. The school-leaving scholarship is the second form. Its object is to send to the Universities boys who will follow a course of scientific or agricultural studies appropriate to the initial training of agricultural officers. Restriction to boys whose parents could not without help send them up to a University may or may not be enforced. Agricultural school-leaving scholarships have for some time past been awarded in certain countries of the Empire. The general opinion appears to be that they serve their purpose well. Provided that the conditions of award recognize the claims and principles of sound education, scholarships of this kind are likely to prove a valuable asset to recruitment.

58. Attention must here be called to an important principle. Early inducement to enter a service is appropriate and justifiable

only if careers in the service are really good. It is thus necessary at this point to place emphasis once more on the proposals in paragraphs 52 and 53. It was affirmed by the Research Special Sub-Committee of the Imperial Conference, 1926, that "It cannot, however, be too clearly stated that in the long run the Government services in question, like other Government services, must rely for recruits on their own intrinsic attractions; special inducements offered at an early stage to tempt young men into a profession cannot make up for inherent deficiencies in the prospects which that profession can provide in salary, pension, status and opportunities."

59. *Colonial Office Agricultural Scholarships.*—A scheme, already in operation, has begun to attract suitable recruits. No pains should be spared to ensure from it the utmost possible value. Suggestions in connection with the scheme are made in Section III below.

60. *Other Scholarships.*—The Empire Cotton Growing Corporation Scholarships have supplied the Dependencies and other parts of the Empire with a valuable body of well-trained officers. Everything possible should be done to induce other commercial bodies to make a similar contribution. This suggestion is made with a wide field of possibility in view. It may well be held that even the manufacturing interests are concerned. A thriving Imperial agriculture is, perhaps, the surest guarantee of a growing market for the Empire's manufactures. The case for assisting agriculture must, therefore, be presented, not as the interest and the duty of agricultural concerns alone. It may be emphatically presented as a fundamental concern of all industries.

61. A *liaison* among awarding bodies is desirable. It does not appear practicable to effect this by a central agency for the Empire or even by separate central agencies for the several Dominions and components. If every awarding body suitably makes known the circumstances of its scholarships and appointments it may be left to the Universities to place these before their undergraduate members. *Liaison* may best be secured by arranging that in any country the awarding Committees have certain members in common. Such a *liaison* already exists between the Colonial Office and the Empire Cotton Growing Corporation.

62. *The Stimulation of Public Interest in the Importance and Value of Scientific Research.*—This is a factor of importance throughout the Empire. It is, therefore, dealt with at length in Section V below.

63. *The Encouragement of Biological Studies in the Universities.*—This is probably the most important step and certainly the most difficult. It involves consideration of a state of affairs which is not the peculiar concern of agricultural science nor of any one country. For some years past the strong tendency among science

students towards reading chemistry, physics and mathematics with no biological subjects, has occasioned grave concern in the biological schools of the Universities. The root of the difficulty lies in school education. In comparison with chemistry and physics, biology is difficult to teach at school. Material and apparatus are relatively costly; competent masters are few; and "cramming" for University Entrance Scholarships offers greater difficulty in biology than in the physical sciences. In every level and type of school education the facts are apparent. Public Elementary Schools, Rural and Urban alike; the "Central" School; the Polytechnic or other institution for evening classes; the Grammar School; the County School; and the larger public schools—one and all testify in their curricula to the inadequate provision for biological teaching. The immediate advantage to employee and employer of a study of chemistry or a technical course in connection with a specific industry probably goes far to explain the neglect of biology.

64. In the face of a difficulty of this magnitude those to whom it falls to assist agricultural education have a difficult task. Successful action will be possible only upon a recognition of the fact that the fundamental interest is one of education, not merely of agricultural education. The help of the many educational authorities concerned must be sought. Among these are county authorities, headmasters, college tutors, and the heads of Universities' Schools of Botany and Zoology. The Universities themselves are deeply concerned, and it is to them that the first approach should be made.

III. The Colonial Office Agricultural Scholarship Scheme.

65. For the Colonial Empire the existing Colonial Office Scheme, modified as experience may dictate, may be expected to meet the requirements of the immediate future. Regulations for this Scheme are given in the Colonial Office Memorandum Misc. No. 280. Certain modifications in the qualifications of scholarship candidates appear desirable. The Conference do not go into detail as they understand that the Colonial Office are already considering a revision of their statement of qualifications. The Conference content themselves with emphasizing the importance of flexibility in the choice of men. University courses vary widely among themselves and character ranks no less than formal qualifications. Wide discretion must accordingly be given to those who administer the Scheme. The Conference think also that rigidity should be carefully avoided in prescribing courses of training.

66. It is understood that, as a fact, the working of the Scheme has been less rigid than the regulations might suggest. It is, however, on the regulations that advice to students must be based. The Conference venture, therefore, to express the hope that the revised regulations will clearly express the flexibility of the Scheme.

67. In view of the importance which the Conference attach to the success of this scheme, they have thought it advisable to record

their opinion on certain points in this and the following section. They realize, however, that in certain respects their views may have already been anticipated by those responsible for the scheme.

68. Careful forecasting of requirements in the Colonial Empire would greatly facilitate the working of the scheme. It would enable selection of scholars to be carried out with confidence and ensure immediate employment to all suitable scholars at the end of their training. The prompt supply to Colonial Governments of trained men to fill their vacancies or newly created posts, is dependent in large measure upon the Governments themselves.

69. In Section IV a two-year scholarship period is proposed. At present the normal, though not necessarily invariable, arrangement is a first year in Great Britain and a second in Trinidad. This arrangement is likely to continue to prove satisfactory. Variation of the arrangement may be necessary in certain cases. An example is the case of the young graduate who, after an honours training in pure science, has qualified himself in agriculture and done advanced work in some branch of agricultural service. Such a man may have spent four years at the University (possibly having entered it as a Scholar of his College in pure science). He is unwilling to apply for a Scholarship which will separate him from an appointment by a further two years of training. Moreover, in the case of an able man, a single year (at Trinidad) would be adequate. It should be possible to send a man of this kind to Trinidad with a one-year scholarship, dispensing with the year of advanced training in England. Many good business appointments are open to graduates at the end of their third University year. The competitive effect of commercial openings would be lessened by the abbreviated training proposed. Abbreviation should be allowed, of course, only to men of marked ability and with the necessary pre-scholarship training. The Colonial Office have adopted this procedure in some instances already, but the Conference understand that power to do so is at present somewhat limited by the financial arrangement in force. It is highly important that the financial provision for the scholarship scheme should impose no difficulty in the adoption of this modification wherever required. In some circumstances, a two year training in Great Britain, with omission of the Trinidad course, might be advisable.

70. It is desired to point out that the Colonial Office scheme, as it now stands, makes no provision for the veterinary service. Such provision is essential if suitable men in sufficient number are to be attracted to the veterinary service.

IV. The Training of Colonial Office Agricultural Scholars.

71. Among both specialist and agricultural officer scholars, initial training is certain to be so diverse that a detailed scheme for post-graduate training is impossible. It has appeared best to set

out basic principles, leaving their application to individual scholars to the expert body by whom the Scholarship scheme will be administered.

72. The broad object of post-graduate training is to develop the Scholar (qualified as in Section III) into the officer (qualified as in Section I). This will involve two periods or phases of training. In the first, spent in Great Britain, gaps in knowledge must be made good and existing knowledge in certain subjects brought to a higher level. Tropical experience—the tropical aspects of practice and scientific applications—will be the concern of the second period. For this the Imperial College of Tropical Agriculture at Trinidad affords facilities.

73. The agricultural officer scholars of any one year, and the specialist officer scholars similarly, will vary greatly among themselves. They will all conform to the broad scholarship standards, but will have widely different individual training needs. A considerable measure of special training must therefore be sought. No one institution can supply this, and reliance must be placed on a careful system of special arrangements with appropriate Universities and other institutions.

74. Personal supervision by senior members of University or other staffs, themselves engaged in investigational work and preferably having teaching experience, is essential to post-graduate training. In many cases normal lecture courses will be appropriate. but every scholar should be under competent personal supervision, As used here "supervision" has the meaning it ordinarily bears in the case of normal post-graduates in a University.

75. All Universities at the present time have to meet considerable difficulties in connection with post-graduate training. Everything possible should be done to ensure that Colonial Office Agricultural Scholars do not add to this unnecessarily. Scholarships should, if possible, be awarded by the end of July. Some University honours lists are not published until a later date, but as experience has shown, this offers no great difficulty. Early application should be made to the University, and there should be an agreed arrangement for admission and the connected formalities.

76. Soundness in fundamentals is the secret of good training. It is no less true that, in many activities, specialization is the secret of progress. But it is only the well-trained man who is equipped for specialization and any form of narrow specialization is undesirable in the post-graduate training of Colonial Agricultural Scholars. A specialist or an agricultural officer, as his career lengthens must inevitably meet a wide range of problems and circumstances. Early specialization might bring him early success in a small field if he chanced to enter it. The soundly trained man will be able to address himself to a diversity of problems and conditions. Short specialist courses should, therefore, be avoided. Reliance should

be placed freely on well-established courses in fundamentals. The measure of specialization desirable must be entrusted to the Supervisor to whom the body administering the scheme would naturally give their guidance.

77. Close co-ordination between the work of the training year in Great Britain and that in Trinidad is essential. Mere repetition of a first year course in Trinidad or anticipation in Great Britain of a course for which Trinidad offers good facilities should be carefully avoided.

78. Scholars in training for either specialist or agricultural appointments should, in each of their years, engage in a certain amount of investigational work. This offers the best means of increasing their observational powers, of encouraging them to plan their work with care and foresight, and of giving them experience in handling data and material.

79. Specialist officers should be able to read scientific papers in French and German, and provision should, where necessary, be made in their post-graduate training to supplement their knowledge of these languages.

80. Flexibility must be ensured in all provisions for training, and in this connection attention is called to Section III, paragraph 69. No code of regulations, however carefully drawn or meticulously observed, can ensure satisfactory training for the bodies of men who will become the agricultural and specialist officers of the future. The personal interest and service of an appropriate body concerned with the recruitment and training scheme are the real guarantee of success.

Part B.

V. An Imperial Basis for Recruitment and Training; and for Interchange of Workers and Study Leave.

81. Agenda: Memorandum I (see Appendix B) placed before the Conference, has discussed the difficulties of instituting an Imperial scholarship scheme. It appears certain that a unified scheme, including all the Dominions and India, would at present be wholly impracticable. Most of the Dominions and India appoint scholars in their own territorial institutions and from time to time send men for post-graduate training at institutions in Great Britain.

82. That scholarships and appointments in the Colonial Agricultural Service should be open to suitable men from all parts of the Empire is so desirable a principle that it need not be stressed here. Selection of overseas candidates would normally have to be made without interview, but it is a pleasure to be able to record that the principle has already found application in a certain number of cases.

83. An Imperial aspect of the problem of recruitment is reflected in a resolution adopted by the Imperial Conference of 1926 :—

> " The Conference recognizes that the progress of scientific research and its effective application to the development of the Empire depends ultimately on an adequate supply of well-trained scientific men ; and that the utmost care is needed in devising suitable conditions for the selection, training, and employment of scientific staffs appointed or aided by Government. Accordingly the Conference commend Part II of the Report of the Research Special Sub-Committee and the suggestions therein contained to the favourable consideration of the respective Governments."

84. Now, the Sub-Committee mentioned in this resolution cited as the first reason for the shortage of recruits " the wholly inadequate appreciation of the importance and value of scientific research on the part of the public, of the press, and even of Governments themselves." It also drew attention to the importance of the right kind of publicity and suggested that the co-operation of schools, colleges, and the press should be secured.

85. There is yet little indication that these suggestions have led to any definite action. It thus seems desirable that the suggestions should be again endorsed and strongly commended to all the Governments of the Empire.

86. Interchange of workers and study leave are matters for which an Imperial basis is considered highly desirable and quite practicable.

VI. Study Leave.

87. Study leave offers so many advantages that it should, as soon as possible, be made a feature of every agricultural service. Staff increases may be necessary to that end. Travel is, of itself, stimulating. To an officer working in comparative isolation, a period of work with an appropriate specialist re-equips him. Reading, for which the duties of most officers in most countries leave inadequate time, may be pursued with the leisure and scientific amenities upon which profitable reading depends.

88. The form of study leave must necessarily vary widely. If spent in a laboratory or institution it should be of such length as to allow at least two months actual work.

89. Tours of a number of institutions, embracing a short stay at each, are likely to be of advantage only to experienced officers.

90. Great care should be exercised in planning study leave. Mere attendance at an institution " to see what is going on " is to be deprecated on many grounds. There should always be a well thought-out course of study or investigation. The institution should be carefully chosen upon competent advice and arrangements with the officers of the institution should be made well in advance. In

particular the time of the leave period should be arranged to avoid inconvenience to the institution and to ensure the fullest amenities to the visitor.

91. The best basis for study leave arrangements is the Imperial basis, the Dependencies acting as a unit of organization. The essentials for an Imperial basis are two: knowledge of facilities throughout the Empire must be made available: a machinery is required for affording detailed guidance and arranging accommodation. Facilities would best be described for each separate unit of the Empire. Every Dominion, including the Home Country, and also the Dependencies as a unit, should prepare and issue a careful statement on "Facilities for Study and Research." This should include not only facilities for agricultural science, but also for the cognate pure sciences. Names of institutions, and of workers, with appreciations of fields of study, should be included. The best form of this publication would probably not be the same for every part of the Empire, but all possible uniformity should be ensured.

92. Detailed guidance and arrangements for accommodation are the second requirement. It appears probable that the Imperial bureaux and correspondence centres could successfully undertake this work. One Imperial "clearing house" for the purpose would result in perfunctory and cumbersome discharge. The final arrangement would have to be effected between worker and worker. The bureaux and centres would serve to put worker and worker into friendly correspondence, and no more than this is needed.

93. One special form of study leave deserves careful consideration. A Government might, with great profit, invite a distinguished worker from another country to visit a number of its centres of research. Here, in an informal friendly way, he could meet men engaged in his own department of study. To some of them he could give direct assistance and information and possibly suggest helpful ideas. For an arrangement of this kind no Imperial machinery would be necessary: advice, if needed, could be obtained through the Imperial bureaux and centres.

VII. Interchange of Workers.

94. That interchange for periods of one to three years might bring handsome advantages is apparent: and the advantages would not be limited to scientific progress alone. But a routine, more or less compulsory, interchange would be extremely undesirable. Beneficial interchanges will suggest themselves. No formal provision is necessary, but financial provision should be made as required. The Imperial basis suggested for study leave would serve here.

95. At present "interchange" in the Empire does not appear to have been developed to the fullest possible advantage. In some of the less wealthy countries the reason for this is definitely the

financial one. Some financial difficulty, direct or indirect, affects the possibility of interchange in all countries. It appears reasonable and proper to ask the appropriate authorities to consider favourably this important means of stimulating research.

5.—Specialist Questions.

96. A list of the committees appointed by the Conference for the consideration of specialist subjects has been given on page 5. The reports of these committees are given in full in the following sections, 6 to 17.

The recommendations of these committees were adopted by the Conference, and, therefore, should be read as recommendations of the Conference, except in the case of those shown in brackets, thus *[ ].

6.—Veterinary Science.

97. In presenting this report on their deliberations during the Imperial Agricultural Research Conference, the Veterinary Science Committee wish to record their appreciation of the unique opportunity which the Conference has afforded of meeting fellow workers in the field of veterinary science throughout the Empire. This is the first occasion on which such a representative gathering of veterinary scientific workers has been held, and these workers have taken advantage of the opportunity to discuss among themselves many problems of the utmost importance in securing and maintaining animal health.

98. While the Committee have not considered it necessary to discuss and report formally upon the many purely technical matters which are of great interest and importance to them professionally, they have discussed them informally, and have undoubtedly derived great benefit, both individually and collectively, from this exchange of ideas. Though it is obvious that in our scattered Empire there are numerous problems of purely local import, there are many others that have a wider significance, and not a few that are common to practically all parts. It is the last category with which the Committee wish to deal at greater length.

99. *Need for a Central Organization.*—Hitherto our research workers, whether stationed in the heart of London or on the outskirts of the Empire, have had perforce to commence the investigation of all their problems in a sense from the beginning. They have had, first of all, to seek out for themselves and secure as best they could any information that may have been accumulated by previous workers in that particular field. The difficulties of an investigator in London were by no means small, though ready access to a number of libraries lightened his burden. The search for accumulated information in periodicals and other publications is always a laborious, and not always a profitable task. The diffi-

culties of the overseas investigator were infinitely greater. If an extreme example is taken, that of a worker in the bush or the jungle, it is obvious that to a large extent he was entirely dependent upon his own unaided efforts. The only works of reference at his disposal would be his own meagre library and any technical publications that might reach him from time to time.

100. If there is one need which the Committee's meetings and deliberations have emphasized more than anything else, it is the need for a central organization of some sort that may act as a clearing house for information relating to animal health, and serve as a connecting link between various workers on that subject throughout the Empire. The collection, collation and dissemination of information alone is not, however, sufficient for their needs. It is also necessary that these workers, and in particular those who work in isolated districts, should have a central organization that may be approached when there is need of information or advice on particular problems.

101. The Committee propose to give briefly a few concrete examples of the disadvantages under which veterinary research workers have suffered in the past through the lack of a common centre of information.

102. (i) In the 'sixties the pastoral industry of Australia and New Zealand was faced with ruin through the ravages of sheep-scab. Steps taken by the authorities to deal with this disease were so successful that in the course of a few years "scab" was completely eradicated; and the flocks of the Commonwealth and of New Zealand have remained free ever since. There is no record published of the exact procedure which brought about this excellent result. "Scab" is still prevalent in many other parts of the Empire, and the experience of Australia and New Zealand might have been invaluable in combating the disease in other countries.

103. (ii) In the 'eighties, pleuro-pneumonia was imported into South Africa in Angora goats, and was successfully treated and eradicated by Hutcheon by a method of inoculation. The details of the method adopted were not made public, and are consequently lost to science.

104. (iii) Active campaigns for the elimination of tuberculosis are being prosecuted at present in several different countries. This disease is of direct importance to many parts of the Empire, and it is most desirable that the fullest possible information both as to methods adopted and the results achieved in different countries, should be made available for the benefit of all workers. Further, the results of the researches on immunity and vaccination now being carried on in various parts of the world would be particularly valuable in combating this scourge. They are being tested in different parts of the Empire, and with fuller information it should be possible to secure such co-operation as would ensure the most

thorough testing of the methods without unnecessary overlapping. Similarly, methods for the diagnosis of tuberculosis vary considerably and a rapid interchange of information in this connection is necessary.

105. (iv) Contagious abortion is causing very serious economic loss at present practically throughout the Empire, and it is highly desirable that the methods of control and diagnosis now in operation and the progress made in the various parts of the Empire should be widely known.

106. (v) To take a recent example, the Committee might instance the dearth of knowledge in the Mother Country regarding foot-and-mouth disease when a Committee was appointed in 1924 to investigate this disease. Despite the fact that Continental workers had been probing the problem for many years, there was no bibliography of their recorded work, and much valuable time had to be spent in searching for reports of previous workers.

107. *Inadequacy of existing facilities.*—The Bureau of Hygiene and Tropical Diseases has for several years devoted some attention to tropical animal diseases, and has published quarterly the " Tropical Veterinary Bulletin." The valuable assistance rendered by this bureau to veterinarians in the tropics dealing with the large group of diseases due to trypanosomes is an excellent example of the useful work which such a bureau may perform. While recognizing the undoubted value of this bulletin, the Committee are of opinion that it cannot meet the requirements of modern tropical veterinary medicine, nor, by reason of its restricted sphere can it deal adequately with subjects which are of importance in temperate climes. Furthermore, there are many essential services required of a bureau apart from the publication of a bulletin, as, for example, those arising out of familiarity with the work in progress at different Institutions in cases where no published reports are available.

108. The Committee respectfully submit, therefore, that the time has now arrived for the establishment of a separate organization to cover the whole field of State veterinary medicine and hygiene throughout the Empire. Animal diseases are of such importance as to necessitate entirely independent intensive study. The Committee are fully alive to the need for the very closest co-operation between the bureau now proposed and any existing or future bureau dealing with correlated subjects. Indeed, provision has been made for such co-operation in the outline scheme which is submitted below.

109. The Committee have considered how best to avoid unnecessary duplication, and would suggest for consideration that economy might be effected in both staff and expenditure if it were practicable to absorb or otherwise incorporate the veterinary activities of the existing Bureau of Hygiene and Tropical Diseases in the bureau now suggested. The Committee accordingly venture

to submit for the favourable consideration of the Imperial Agricultural Research Conference the following outline scheme :—

Proposed Bureau of Animal Health.

110. *Scope.*—It is not proposed to cover the whole field of veterinary science, but to concentrate on those branches dealing with State veterinary hygiene and State veterinary medicine, including legislative measures for the control of animal diseases.

111. *Objects.*—(i) Information and Advisory.

(*a*) The publication of a bulletin.
(*b*) The collection, collation and distribution of general information.
(*c*) The preparation of special reviews of information regarding specific diseases of importance throughout the Empire.
(*d*) The collection and the summarizing of statistics relative to animal diseases.
(*e*) The preparation of surveys of legislative measures relative to the control of animal diseases.
(*f*) The extraction of information from official records not readily available to the individual worker.
(*g*) The giving of advice to individual workers visiting Great Britain with regard to post-graduate instruction, purchase of apparatus, &c.
(*h*) The initiation of periodical conferences.

(ii) The recognition of the right of all Agricultural Departments and accredited Government workers in any part of the Empire to correspond direct with the bureau in scientific and technical problems and to make enquiries.

(iii) The establishment and maintenance of contact between Institutions and between individual workers dealing with similar problems, and also between isolated workers and appropriate Institutions.

(iv) The reception of material and its transmission to appropriate Institutions for identification.

112. *Location.*—The headquarters of the bureau should be in London.

*[113. *Organization.*—The bureau should be independent and controlled by a management committee containing veterinary workers representative of all parts of the Empire, and other persons representative of such similar organizations as deal with correlated subjects. The bureau should be in charge of a Director and an Assistant, both veterinarians, together with a Secretary-Librarian and the necessary clerical staff.

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* See footnote on page 34.

114. *Finance.*—It is obvious that an adequate grant would be required for expenditure on the necessary furniture, fittings, books, &c.

Annual expenditure :—	£
Director's commencing salary	1,000
Assistant's commencing salary	800
Secretary-Librarian	400
Clerical staff	600
Superannuation	220
Publication of Bulletin, including printing, abstracting and translations	1,000
Publication of special reports	200
Rent and incidentals	780
	£5,000

No account has been taken of the receipts from the sale of publications.]*

Increased Flexibility in Examination Requirements for the Veterinary Service.

115. The Committee were asked by the Administrative Commission to consider the question of increased flexibility in examination requirements for the veterinary service ; and in particular whether credit should not be given to students in other sciences for the years they have spent in study in those sciences when they pass over to a veterinary training, as is the case in other subjects than veterinary science.

116. The Committee are informed that, according to the current regulations of the Royal College of Veterinary Surgeons, and some other Colleges in the Dominions and Colonies, students of other sciences are granted certain exemptions when they pass over to veterinary training. The appropriate byelaws of the Royal College of Veterinary Surgeons, which may be quoted as an example of the concessions that may be made, are as follows :—

> " (i) A student who has obtained a degree in Arts, Science or Medicine, or a degree or diploma in Agriculture granted by a University situated within the United Kingdom, or by any other body whose degree or diploma in Agriculture is approved for the time being by the Council on the recommendation of the Examination Committee, or the Diploma of Licentiate of one of the Royal Colleges of Surgeons, or of one of the Royal Colleges of Physicians, and who, in procuring any such degree or diploma, passed an examination in Chemistry and also in Biology, Zoology or Botany, and any matriculated student who produces

* Paragraphs 113 and 114 were not adopted by the Conference.

evidence of having passed with honours an examination in Chemistry and Physics, and also in Biology (Botany and Zoology), as part of his course for a degree in Arts, Science (exclusive of Veterinary Science) or Medicine, shall be exempted from his A or First Professional Examination, and the byelaws and regulations in respect thereof, and shall be entitled in all respects to the rights and privileges which the passing of such examination ordinarily confers."

" (ii) A student possessing a degree or diploma of a like import or denomination to one of those enumerated in paragraph (i) hereof, but granted by a University or other examining or licensing authority other than those mentioned in paragraph (i) shall, if the Council declare its sufficiency for exemption, thereupon become entitled in all respects to such exemptions, rights and privileges as are defined in paragraph (i) of this byelaw."

117. Somewhat similar concessions are also granted by the Punjab Veterinary College, which enable exempted students to take the veterinary course in three, instead of four, years. In South Africa and Australia the veterinary students take the scientific subjects of the first year in common with students of all other faculties, but it may be mentioned that in the Union the veterinary students must, in addition, take a four years' course.

118. While in sympathy with the fullest practicable degree of flexibility, the Committee, after careful consideration of the requirements of veterinary science, unanimously expressed the opinion that adequate specialized professional training cannot be accomplished in less than three years. Furthermore, the Committee feel that every effort should be made to encourage students to take University degrees, and to this end would strongly recommend the institution of undergraduate scholarships.

7.—Animal Nutrition.

119. The Animal Nutrition Committee made the following recommendations :—

Proposed Bureau of Animal Nutrition.

120. The establishment of a bureau or information centre for the exchange of information on Animal Nutrition is desirable.

121. The functions of the bureau should be :—

(*a*) To supply on request information of a general practical nature to officials and advisory or administrative officers in all parts of the Empire.

(*b*) To supply on request scientific information, e.g., bibliography of literature and loan of reprints, to research workers on specific problems.

(*c*) To collect information bearing on specific problems under investigation in different parts of the Empire for circulation by means of reviews, monographs or otherwise.

(*d*) To arrange from time to time, as found desirable, meetings of workers engaged on the same problem in various parts of the Empire.

(*e*) To make suggestions for, and to arrange on request, exchange of workers.

(*f*) To arrange for the examination of Empire products connected with the feeding of animals in cases where local facilities are not available.

*[122. The bureau should be governed by a technical Committee of experts in Animal Nutrition, this being responsible to an Executive Committee of representatives of the Governments who supply funds.

123. It is suggested that the bureau should be begun on a small scale, and should expand only in response to definite demands for increased activity. In the early years expansion should be carried out by temporary workers. It is suggested that for the first five years the bureau could be run on an annual income not exceeding £3,500, provided that the surplus of one year be carried over to following years.]

124. It is proposed that the bureau be at first located at the Rowett Institute. It is understood that there should be close co-operation between the Rowett Institute and Cambridge, and that Professor Wood be Chairman of the Technical Committee.

8.—Animal Genetics.

125. *Introductory.*—The Committee, holding that the need for immediate solution of problems in animal reproduction is not so urgent as in the case of those concerned with such aspects of agricultural endeavour as marketing or disease control, recognize that there are many present disabilities that demand for their investigation a thorough comprehension of the principles of genetics, and that advances in livestock breeding, which will be demanded in the mmediate future, can, indeed, only be secured through the present application of these principles in critical experimentation.

126. *Need for further Research.*—The Committee are of opinion that there is clear need for investigation in this field, and that problems and experimental material are abundant, awaiting the coming of men with the genetical point of view and skilled in

* Paragraphs 122 and 123 were not adopted by the Conference.

genetical techniques. The problems, the solution of which promises immediate benefit to livestock breeding, are concerned with :—

(*a*) The relation of form to function, e.g., dairy cattle.
(*b*) The relation of type to environment, e.g., sheep and their distribution.
(*c*) Disease resistance.
(*d*) The various systems of breeding and the value of these.
(*e*) The oestrus cycle, fecundity and fertility.

127. The Committee recognize that the work at Edinburgh and at Cambridge on the physiology of reproduction is complementary, and recommend that this work should be given the fullest possible opportunities for development.

128. The Committee desire to draw attention to the fact that the application of genetical science to animal improvement is being hindered by the lack of exact physiological knowledge of the animals of the farm, and, therefore, strongly recommend that throughout the Empire efforts should be made to encourage the formation of active centres of research in animal physiology.

129. *Training and Supply of Workers.*—The Committee consider that one of the first problems to be investigated and solved is that of giving to those who are to be concerned with livestock breeding and improvement an understanding of genetics. It may not yet be practicable everywhere to bring this subject sufficiently into the undergraduate curricula of agriculture and veterinary science, but the Committee are of opinion that the different Governments should make it possible for appropriate officers to attend such courses whilst on study leave. The Committee hold the view that there will be no scarcity of such men when there are opportunities for these on the staffs of educational and research institutions, and in Government agricultural and veterinary services throughout the Empire. The Committee do not recommend that special billets for animal geneticists should be created, save perhaps on the staffs of certain selected institutions, but they consider that it is highly desirable that the veterinary officers of the tropical and sub-tropical colonies, and the animal husbandry and livestock specialists of the Dominions should be equipped with an advanced knowledge of this subject. The Committee consider that the atmosphere of a University would be particularly suitable for such a training, and that, in view of the general cultural opportunities and of the existence of a wide variety of breeds the training centre should be situated in Great Britain.

130. *Establishment of Training Centre.*—The Committee are strongly of the opinion that such a University centre should be adequately equipped for :—

(*a*) The undertaking of fundamental genetical experimentation on a sufficiently large scale with the larger domesticated animals of economic importance.

(*b*) The training of overseas graduates coming thereto immediately after graduation for a period of time, at the end of which they would proceed to an advanced degree within the University.

(*c*) Supplying facilities for study leave to specialists who have already served some years in a particular part of the Empire and have developed during their routine work there an acquaintance with its peculiar problems and needs, and a consciousness that it has become imperative that they should equip themselves with further knowledge.

131. The Committee accordingly recommend that the Animal Breeding Research Department at Edinburgh should be regarded as the centre for this work in animal genetics, and that the facilities already existing should be amplified and developed for this purpose.

132. It is essential that there should be an adequate staff and laboratory accommodation ; colonies of the usual experimental animals ; an experimental poultry breeding plant ; and, in addition to these, a farm.

133. The Committee also recommend that steps should be taken by the Governments of the Dominions and India and by the Colonial Office to create or to increase the number of post-graduate fellowships which would enable suitable men to come to this centre.

134. *Information Centre.*—The Committee recommend that the Animal Breeding Research Department at Edinburgh should also serve as a Centre for the collection and dissemination of information in Animal Genetics. The establishment of an Information Centre and bibliographic service would not only greatly assist the functioning of this Department, but would at the same time make it possible for research workers in all parts of the world to profit thereby. The functions of the Centre would be as follows :—

(i) All scientific papers dealing with animal breeding would be indexed and, when necessary, abstracted, and an up-to-date library of books would be maintained.

(ii) Reports from all agricultural institutions dealing with the different aspects of animal breeding would be received and questionnaires seeking unpublished information would be issued.

(iii) For the dissemination of information, a mailing list of all institutions and specialists interested in animal production would be maintained, and to these at frequent intervals lists of classified titles and references would be sent.

(iv) Abstracts of papers would be prepared and dispatched on request.

(v) Information on any particular subject relating to animal breeding would be sought for any specialist or institution as requested.

(vi) The library and indices would be open to all responsible workers.

(vii) Arrangements would be made whereby authoritative reviews of particular aspects of animal breeding would be written and published.

*[135. The Committee consider that for this purpose a librarian and assistant librarian with the necessary technical knowledge should be provided and they estimate that a sum of £2,000 per annum would be required for the necessary staff and facilities.]

136. As already indicated the Information Centre would be located at Edinburgh, but the Committee suggest that it might with advantage be supervised by a joint Consultative Committee of Edinburgh and Cambridge geneticists.

9.—Dairying.

137. The Committee are impressed with the extent to which the continued prosperity and progress of the dairy industry throughout the Empire is bound up with the systematic prosecution and development of research in dairying. The Survey of Dairying and Dairy Research in the Empire shortly to be published by Professor R. H. Leitch, M.A., B.Sc., advance copies of which were circulated to the Committee, affords striking evidence of the need for further research and of the advantages to be obtained from mutual co-operation and interchange of information.

138. *Need for Organized Research.*—The dairy industry of the Empire has developed in recent years with exceptional rapidity, and has attained a high degree of efficiency with the technical aid of Departments of Agriculture, but with comparatively little assistance from organized scientific research. The Committee note with interest the projects for the establishment of dairy research institutes in several parts of the Empire to study fundamental problems of the dairy industry. The Committee also desire to draw the attention of Governments to the need for further study of nutritional and breeding problems and of the physiology of milk production, as likely to be not merely of scientific value, but of practical economic advantage. They further desire to stress the importance of systematic investigation of the economics of dairy production.

139. *Experimental Work on Quality of Imported Produce.*—One of the most fruitful fields for co-operation between workers in Great Britain and overseas is the study of such defects as are found in the condition and quality of imported dairy produce, and the possibility of effecting improvements in flavour, carrying quality, &c. While there is ample evidence that the great bulk of imported Empire dairy produce reaches a high standard of quality, it is, nevertheless,

* Paragraph 135 was not adopted by the Conference.

necessary that steps should be taken to improve the quality of the inferior grades. The study of this problem extends from methods of production on the farm right up to the handling of the finished article in the British market, and the Committee recommend that the Governments of the Empire should initiate and encourage experimental work of this character.

140. *Standardization of Glassware used for Testing Milk and Milk Products.*—The Committee desire to endorse a suggestion made by the National Physical Laboratory as to the need for establishing greater uniformity throughout the Empire in the official specifications prescribed for volumetric glassware used in testing milk and milk products. Greater co-ordination in this field would enable the testing authorities in different parts of the Empire to work on a common basis and obtain results of greater scientific value ; and, in addition, the manufacturers of glassware would have the assurance that apparatus made in accordance with the agreed regulations would be marketable in any part of the Empire. The Committee recommend that steps should be taken to collect information on existing methods and standards with a view to suggesting a practical scheme for standardization of glassware for testing milk and milk products throughout the Empire.

141. *Interchange and Training of Workers.*—While the Committee realize that there are administrative difficulties in arranging for the mutual interchange of whole-time workers, they desire to stress the importance of promoting :—

(*a*) visits by research workers in the Dominions to Research Institutes in Great Britain ; and

(*b*) visits by British research workers to the Dominions.

142. The Committee suggest that part of the funds made available for dairy research by the Empire Marketing Board and Overseas Governments might be devoted to this purpose with results of the utmost benefit to the development of research both at home and overseas.

143. The Committee would also welcome any scheme for facilitating visits of research workers and dairy officers for courses of special training in different parts of the Empire.

144. *Interchange of Information.*—The Committee have considered the question of setting up machinery for facilitating the collection and dissemination of information in dairy research. Until organized research in dairying has been further developed, it appears to the Committee that the time is not ripe for the establishment of an Imperial bureau on lines similar to the Imperial Bureaux of Entomology and Mycology. The Committee are impressed, however, by the fact that original work in problems relating to different aspects of dairying is now scattered through a great variety of different types of journal. Much of the labour, which is at present necessary if the research worker is to keep himself

abreast of the literature, would be saved if it were possible to circulate regular summaries of such work and to establish an Empire journal devoted to the publication of papers relating to dairy research.

*[145. *Dairy Research Committee.*—The Committee recommend the formation of an Empire Dairy Research Committee in London, including representatives of British Government Departments of Agriculture, Research Centres and Departments (such as the National Institute for Research in Dairying and the Low Temperature Research Station), and representatives of overseas countries of the Empire specially interested and the Empire Marketing Board, which would meet from time to time and discuss schemes of mutual assistance in the sphere of Dairy Research. The Committee suggest that one of the first tasks of the proposed Committee should be to explore the best means of securing systematic collection and dissemination of information, and the publication of the Journal suggested in the previous paragraph.]

10.—Soils and Fertilizers.

I. Functions of a Soil Bureau.

146. The Committee are greatly impressed with the need for some organization to carry out work in the direction indicated below, and wish to urge upon the Conference the desirability of establishing a Soils Bureau or other similar organization, the main functions of which should be :—

(i) The systematic collection and circulation of information enabling all soil workers in the Empire to keep in touch with the recent developments of their science. It is suggested that this can be done most effectively by (*a*) the development of a library from which workers with inadequate facilities can obtain information on specific subjects, and from which photostatic copies of papers can be sent out, and where work published in less known languages can be made generally available ; (*b*) the establishment of a Journal whose purpose would be to publish important work unsuitable for publication through the usual channels, analytical data and other notes and information on soils and fertilizers, and generally to bring into close relationship soil work throughout the Empire.

(ii) Co-operation in the organization of Soil Surveys in the Empire by (*a*) the working out of methods for use in field and laboratory ; (*b*) identification of soil minerals and furnishing of complete mineralogical and chemical analyses, (*c*) the development of new work and assistance in

* Paragraph 145 was not adopted by the Conference.

co-ordination of existing surveys; (*d*) the formation of a collection of the principal soil types of the Empire; (*e*) the publication of results.

(iii) Advice and assistance in the organization of experimental work on the maintenance and increase of soil fertility by cultivation, fertilizers, irrigation and other means.

(iv) The arrangement of visits by the officers of the bureau and other specialists in various branches of soil science from Britain to places overseas and general assistance in the organization of the interchange of workers.

(v) The organization of specialist conferences.

(vi) Assisting in any other way within their purview the agricultural officers overseas.

147. The Committee consider that the functions of such a bureau as is contemplated can only be effectively carried out in the closest association with a research institute dealing with soil problems.

148. The Rothamsted Experimental Station is the leading institute for soil research in the Empire, its library facilities are unique, and its staff is engaged on a wide range of research on soil problems. The Committee are, therefore, of opinion that the bureau should be located at Rothamsted, *[and consider that it is essential that it should be under the general control of the Director of the Rothamsted Experimental Station].

149. Requests have been made by the staffs of the smaller Colonies and Dependencies for the provision of further laboratory facilities, where men on leave can themselves study recent methods, and carry out other experimental work and obtain such information as they may require. The consideration of these requests, and of others of wide regional and possibly Imperial significance, and recommendations as to the best methods of providing the necessary facilities, should be a function of the new organization.

*[150. *Finance.*—After careful consideration the Committee estimate that the annual cost of the Institute equipped to carry out the functions enumerated above will be £4,000.]

II. Technical Subjects.

The following technical subjects have been discussed.

151. (i) *Soil Classification.*—A memorandum on Soil Classification has been drawn up by two members, Professor G. W. Robinson and Dr. W. G. Ogg, to whom the Committee are greatly indebted. This should be passed into the bureau as soon as it is established and form the basis of a publication to be circulated for the guidance of soil chemists in the Empire.

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* The last part of paragraph 148, and paragraph 150 were not adopted by the Conference.

152. (ii) *Methods of Mechanical Analysis of Soils.*—Various methods of mechanical analysis are at present in use and it would appear desirable to agree upon some standard method. This has been found impossible so far, but the Committee have passed the following resolution, which they ask should be brought to the notice of soil analysts throughout the Empire without undue delay :—

> "It is desirable that, where soil survey data are to be published, the mechanical analysis should be made by the international method or by some other method which has been shown to give the same results, it being recognized that certain soil types such as laterites and highly calcareous soils require special methods."

153. Details of the various methods in use have been collected and should be studied by the new bureau with the view of simplification, and, where possible, unification.

154. (iii) *Fertilizer Trials.*—The Committee have examined the possibility of securing some degree of uniformity, sufficient at any rate to ensure comparability of results, in the fertilizer trials throughout the Empire. Differences in crops and conditions are so great as apparently to preclude the possibility of agreement on details, but there are certain principles which in their view should be regarded as fundamental in all such work. These have been embodied in a short memorandum, which should be elaborated by the new bureau and circulated throughout the Empire.

155. (iv) *Soil Deterioration resulting from Shifting Cultivation, Disafforestation, &c.*—An important discussion on this subject revealed the great losses suffered by various parts of the Empire from these causes. Memoranda are being drawn up by officers having expert knowledge of particular cases : these should be handed in to the bureau for detailed study, for the making of suitable suggestions for experimental work, and for recommendations to the proper authorities.

11.—Plant Breeding.

156. In view of the economic importance of plant breeding to the Empire, the number of workers engaged on plant breeding problems, and the large amount of new information in the science of genetics not yet fully applied to practical plant breeding problems, the Committee desire to urge on the Conference the desirability of establishing an organization the main functions of which are set out below.

157. *Functions of suggested Organization.*—(*a*) To collect, classify and disseminate information of a scientific and technical character relating to plant breeding methods and plant breeding technique

in order that all workers in this field might be kept in touch with the recent developments of their science; also to assist plant breeders in securing information relating to the value and suitability of the products upon which they are working for trade or manufacturing processes.

(*b*) To establish direct contact between institutions or groups of workers dealing with closely related problems around which information is being collected.

In this connection the Committee attach great importance to occasional visits by senior officers to institutions and groups of workers overseas. Such visits would ultimately bring about a close linking of organizations and workers with the central institutions in Great Britain.

(*c*) To facilitate the exchange of ideas in devising programmes of research on plant breeding projects. Workers in Agricultural Departments with problems to solve should be able to apply to the information centre for advice and literature bearing on their problems.

(*d*) To facilitate the exchange of plant breeding material among institutions and workers in different parts of the Empire.

(*e*) To afford opportunities to overseas workers to increase their knowledge of plant breeding research or to work on plant breeding problems during a period of study leave or otherwise. The Committee recommend that the Governments concerned should afford facilities for this purpose.

(*f*) To issue as soon as is practicable a journal in which technical information on plant breeding, the technique of field testing of farm crops, and information on the testing of the economic qualities of their products would be published, together with occasional reviews of the most notable advances made in plant genetics, and such other features as may be found advisable.

158. *Location of Centre.*—The Committee consider that the functions of such an organization as is contemplated in paragraph 157 could be most effectively carried out in close association with existing research institutes engaged on plant breeding problems.

159. Suitable centres for this work would be:—

(i) The Institute for Plant Breeding, Cambridge University.
(ii) The Welsh Plant Breeding Station, Aberystwyth.

160. The former would be a suitable centre for crops of the tropical, sub-tropical and temperate zones, the latter for work on herbage plants.

*[161. The Committee consider that the organization should be provided for by increasing the staff of the Institute or centre concerned, the additional workers engaged being subordinate to the Director of the Institute.

* Paragraphs 161 and 162 were not adopted by the Conference.

162. *Probable Cost.*—The Committee consider that, apart from capital cost for accommodation, the annual recurrent expenditure required to provide for the necessary staff of scientific and clerical officers, and for the cost of publications, translations, preparation of reviews and maintenance, would be approximately £4,000 per annum. Of this total recurrent expenditure it is estimated that £2,500 per annum would be required for the centre at Cambridge and £1,500 for that at Aberystwyth.]

12.—Plant Pathology (including Mycology).

163. *Notification of Plant Diseases within the Empire to the International Institute at Rome.*—The Committee were advised that a number of Governments had received a request from the International Institute of Agriculture at Rome for official information concerning plant diseases and pests, and for early notification of outbreaks of new plant diseases in their territories. The Committee learned that the Institute was already supplied monthly with a copy of the Ministry of Agriculture Summary of Plant Pests and Diseases, prepared at their Plant Pathological Laboratory, and with a copy of the Review of Applied Mycology, published monthly by the Imperial Bureau of Mycology. After discussion the Committee arrived at the conclusion that these Reports appeared to be all that was necessary to meet the requirements of the Institute.

164. *Lists of Plant Diseases in the Empire.*—The necessity for the preparation and publication of such lists was urged, and after discussion it was decided to report that the Committee are of opinion that the preparation, by the Governments concerned, of lists of plants diseases occurring in the Empire, especially in the tropical dependencies, is desirable, and that such lists should be revised as and when desirable and possible ; further that the Committee are of opinion that the Imperial Bureau of Mycology is a very suitable body to publish and distribute such lists, when prepared.

165. *Uniformity of Nomenclature in Connection with Plant Diseases.*—The Committee learned with satisfaction that the British Mycological Society has under preparation a list of common and scientific names of plant diseases with a view to securing more uniform nomenclature. They desire to call the attention of Empire Mycologists to this undertaking, and would be gratified if the British Mycological Society could see its way to circulate this list, when published, to all Governments of the Empire. The Committee recognize that some financial aid to the Society will be required if this project is to be carried out.

166. *Plant Pathologists' Library.*—The Committee discussed the needs of mycologists for adequate libraries, and beg to recommend (1) that the Imperial Bureau of Mycology be asked to prepare a list of books and periodicals to be regarded as the minimum require-

ment for a Government mycologist, such a list to be added to, or amended from time to time, if necessary; and (2) that a copy of this list and subsequent amendments be forwarded to the Departments concerned.

167. *Interchange of Official Publications.*—The Committee considered the interchange of official publications and were strongly of opinion that overseas Governments be recommended to supply all papers and bulletins on Mycology and Plant Pathology published officially to the Institutions mentioned in a list, to be prepared in the first instance by the Imperial Bureau of Mycology, and amended, or added to from time to time.

168. *Virus Diseases.*—The Committee, impressed by the importance of the subject of virus diseases in plants, devoted an entire session to the discussion of the subject in all its aspects. The discussion, which was helpful and instructive, led to the submission by the Committee of the unanimous recommendation that, in view of the urgency of the problem, no time should be lost in the provision of funds for the more extended study of the fundamental nature of virus diseases in plants.

13.—Fruit.

169. The development of a fruit plantation to a successful issue is expensive, and takes many years; in fact, so far as some tree fruits are concerned, planting is often done for posterity. The agriculturist on the other hand, usually sees the whole succession of events, from seed time to harvest, within the period of a year or two; and he is thus able to repair mistakes without serious loss. The fruit grower encounters an immeasurably greater loss if he makes an error in the establishment of his orchard. For instance, in the case of the tree fruits, it usually requires a number of years (up to ten or fifteen in the case of certain fruits) to bring the orchard to the point of profitable bearing. Mistakes made at the outset may not be discovered until that time has elapsed and these mistakes cannot be rectified without a considerable further loss of time.

170. This being so, it is vital that knowledge should be available to the grower which will enable him to foretell, with some reasonable degree of certainty, the future performance of his trees.

171. The serious pitfalls into which fruit growers have fallen in the past, owing to the insufficiency of technical knowledge, may be illustrated by some common examples taken from the observations of horticulturists throughout the Empire.

172. (i) *Unsuitable Varieties.*—In every fruit-growing district there are numerous instances of varieties unsuitable to local conditions.

173. (ii) *Wrong Varieties.*—In some parts of the Empire, there are frequent examples of fruit plantations which are unprofitable because the variety planted turns out to be not that which the grower believed he was planting, but a rogue of very inferior value.

174. (iii) *Unsuitable Root Stocks.*—The effects of unsuitable root stocks are far reaching, and the use of such has often led to disaster. Thus, trees in localities where winter-killing is prevalent, often die by the time the bearing age is reached, because the roots are not hardy under these conditions.

175. Root stocks determine to a large extent the size, cropping and longevity of the tree, and also its susceptibility or resistance to certain diseases, and influence the quality of the fruit. Disappointment and loss result unless the appropriate stock is used.

176. (iv) *Self Sterility.*—Recent investigation has shown that many varieties of fruits are self sterile. They must be pollinated by other varieties if a crop is to be obtained. This applies to apples, pears, plums, and cherries in particular, and is undoubtedly a common cause of the all-too-frequent barren orchard.

177. (v) *Unsuitable Environment.*—Each of the various components, grouped together under the name of climate, produces specific effects on the growth of trees. It is well known that abnormally heavy rainfall adversely affects fruit bud formation, while liability to frost, with its attendant risk of blossom and other injury, may render an otherwise favourable site totally useless. It also frequently happens that cultural methods and other practices aggravate the ill-effects of certain climatic conditions.

178. Suitable conditions in the soil are fundamental to the successful growth of fruit, and attempts to produce them in soils where conditions are unsuitable are invariably attended by only partial success or by complete failure.

179. (vi) *Unsuitable Manuring.*—It is generally acknowledged that the subject of the manurial requirements of fruit trees is very imperfectly understood. Often the treatments given are not only negative in their effects, but are positively injurious, and result in severe damage to the tree.

180. Associated with the pitfalls to which attention has just been drawn is the whole field of pests and diseases with which the fruit grower has to contend.

181. Any one of the above may be sufficient to cause the total failure of a particular enterprise and the labour of years may even end in the ruin of the grower.

182. There is thus a very special case for scientific aid to the fruit industry, on account of the risk and the absence of material return from the invested capital for a prolonged period after its original outlay. From this point of view, the nature of the assistance most imperatively needed is to ensure to the grower that the

material with which he has to deal in establishing his orchards and plantations is of the requisite standard for success, and that the sites selected for these orchards and plantations and the treatment applied to them after establishment, are adapted to produce profitable results. In other words, the two most pressing lines of investigation are those concerned with the material to be used and the conditions affecting nutrition, including soil, climate and manurial and cultural treatments. Each of the illustrations given above indicates specific problems to be faced which fall under one or other of these heads.

183. *Material and Nutrition.*—As regards material, it is of the highest importance that the trees of the varieties which the grower proposes to plant should be true to name, and suitable for the purpose in view.

184. In the Committee's opinion the most pressing of the many lines of inquiry in this connection are those relating to the production of trees most suited to the conditions under which they will be subsequently grown. In particular, the subjects of root stocks and the inter-relation of these and the scion varieties call for extended research.

185. In research and field experiments the use of standardized material is essential.

186. The failure in the past to use such material accounts for the negative results so often obtained in field trials.

187. Environmental factors, such as seasonal temperatures, sunshine, rainfall, humidity, the texture, moisture, and other conditions of the soil, the nutrients available, &c., have direct effects on the nutrition of the tree, and on the quality of the fruit produced.

188. The provision of the correct type of tree for the grower cannot be achieved without the necessary knowledge as to the reactions of the various types to the environmental conditions under which they may be grown. A decision as to what constitutes the right type of tree in a particular case cannot be arrived at without such knowledge, and it follows that the two main lines of investigation thus involved must be considered complementary and must be pursued concurrently.

189. The Committee consider that, of the lines of work involved, particular attention should be given to the following :—

(*a*) The study of stock and scion and their inter-relations, as mentioned above.
(*b*) Surveys of fruit areas to determine the relation of various factors to tree growth and fruitfulness.
(*c*) Chemical studies relating to the tree and its crop.
(*d*) The associated physiological studies.

Much that has been said in relation to fruit trees is equally applicable to the cultivation of fruits in general, and also to viticulture.

190. While the Committee have considered it desirable to bring forward thus prominently the subjects of material and nutrition as those which should be most strongly supported for fuller investigation, they also recognize that there is a strong case to be urged for the further development of research on the problems of transport and storage, preservation and by-products, and disease control.

191. *Preservation and By-products.*—In the case of perishable material such as fruit, it is essential that means should be available whereby produce which, in its fresh state, cannot be marketed while still in good condition, can be disposed of as canned, dried or otherwise utilized material. Industries of this kind associated with fruit culture are at present comparatively undeveloped throughout the Empire, and, as regards the obtaining of the necessary technical knowledge and assistance in the problems involved, the British Empire fruit grower and preserver is as yet much less favourably situated than his competitors in the United States. He has still to rely mainly upon that country for technical knowledge, while he is almost entirely dependent on the United States manufacturer for the machinery and plant required for the processes of preservation.

192. The Committee regard this situation as contrary to the interests of the British fruit-growing industries and urge the importance of the provision of a suitable centre or centres for research and advisory work within the Empire.

193. *Disease Control.*—Notwithstanding the considerable efforts which are being made by plant pathologists and entomologists throughout the world to control plant diseases and pests, the fruit-grower is still subject to extremely heavy losses.

194. Another line of investigation, which is full of promise and has as yet been hardly touched, is that concerned with varietal disease resistance and susceptibility and the nutritional and other factors influencing the degree of infection or of intensity of attack.

195. There is an admitted need for the extension of research to discover new insecticides and fungicides outside the very limited group of materials at present available.

196. These questions appeared to be of such importance and urgency that the Committee thought it proper to convoke a special meeting to discuss them with entomologists and mycologists attending the Conference. The resolution passed by the joint meeting will be found in Section 15, paragraph 222.

197. *Proposed Imperial Horticultural Committee.*—The most important part of any scheme must be to provide machinery whereby the results of research work may be disseminated, so that its full

advantage may be realized. For this reason the Committee have considered the advisability of establishing a bureau or a correspondence centre to carry out this work.

*[198. They feel, however, that neither of these methods would achieve the results which they have in view. They think that better results would be obtained by establishing in Great Britain a Committee to carry out this work.

199. In order to facilitate the co-operation of research workers in horticulture throughout the Empire, and the interchange of information concerning research, it is suggested that an Imperial Horticultural Committee should be set up.

200. The members of this Committee should be well acquainted with horticultural practice, and with scientific research in horticulture. The Horticultural Research Stations in Great Britain, and the Ministry of Agriculture should be represented, and there should be members representing such self-governing Dominions as are interested in horticulture. Empire countries other than Dominions might be grouped, so that one representative could speak for each part of the world where essentially similar problems arise. Perhaps the Colonial Office might be asked to select representatives for the Colonies.

201. The Committee should be prepared to meet quarterly.

202. The Imperial Horticultural Committee might form Publication and Information Sub-Committees in Great Britain and overseas. The Publication and Information Sub-Committee in Great Britain would undertake the issue of a quarterly journal.

203. Representatives of the Sub-Committee would be asked to report on any new problems needing urgent research. The Committee would study the working programme of the various Research Stations and would discuss the lines of work in progress.

204. The duties of the Imperial Horticultural Committee would include the following :—

(i) To take note of research problems as they arise, and to bring them to the notice of Research Stations.
(ii) To watch over the research work which is being done.
(iii) To arrange for the best method of circulating information with regard to research work.
(iv) To make a special examination of the work at any Research Station on problems of outstanding importance. For this purpose it might be desirable for the Committee to send a representative to any Research Station where work of particular interest is in hand, and to obtain a first-hand report on the progress of such work.

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* See footnote, p. 51.

(v) To consider and suggest methods of correlating research work of Empire importance, and to encourage the interchange of visits among research workers throughout the Empire, as explained below.

(vi) To receive and deal with any enquiries on horticultural research subjects which may be sent in by Research Stations, Scientific Institutions, or Government Departments in any part of the Empire.

205. The Imperial Horticultural Committee would require a small permanent staff, which should include the following :—

(*a*) A full-time officer, who should have both linguistic and literary capabilities, in addition to a training in agricultural science. This officer should work in close association with horticultural research, and should be in touch with an adequate horticultural library.

(*b*) For office work, and for the care of the Library certain clerical assistance would be necessary ; and arrangements would have to be made for the maintenance of the Library.

206. It is suggested that one of the most effective ways of disseminating information on horticultural research would be through the medium of a quarterly journal. The circulation of this journal should be as wide as possible. It should be on sale at a price at least sufficient to cover a part of its cost of production.

207. It is thought advisable that the Editor of the journal should also act as Secretary to the Publication and Information Sub-Committee in Great Britain, and to the Imperial Horticultural Committee.

208. There is already in existence a publication ("The Journal of Pomology and Horticultural Science"), which provides, to some extent, an information service of the kind envisaged. This might be enlarged, so as to include papers from all over the world dealing with fruit, vegetables and other horticultural crops. It should broaden its basis so as to include :—

(*a*) Summaries or "enlarged titles" of important papers published elsewhere.

(*b*) *Résumés* covering a complete field of investigation, such as those asked for by the Empire Marketing Board from Long Ashton and East Malling, or the present viticultural survey.

(*c*) An extension of book-reviewing.

[209. While the chief part of this abstracting work would have to be undertaken by the full-time Editor, Sub-Committees of specialists would doubtless contribute to the journal whenever possible, and would also give advice on the Editor's own abstracts.]*

* Paragraphs 198 to 209 were not adopted by the Conference.

210. *Interchange of Workers.*—The Committee are impressed by the economic value of the work which is being prosecuted at the Horticultural Research Stations of the Empire. It would be of the utmost benefit to fruit culture, both at home and overseas, if facilities were granted to the research workers of British stations to make extended tours of the overseas fruit areas ; and for overseas workers to visit Great Britain, and, perhaps, to work for a time at British stations.

211. Such visits would enable these workers to meet those engaged in similar investigations in other Empire countries, and would ensure the full discussion of problems of mutual interest. Such questions as the utilization of standard stocks for experimental work, the suitability of particular stocks for special types of soil, the bearing of nutrition on " Leaf scorch " and other troubles of the like nature, would in this way form topics of discussion among visiting workers and their hosts, in circumstances which would allow of due weight being given to the influence of local conditions.

212. The benefit of such visits would not be confined to fruit workers overseas, but would also accrue to the fruit industry of Great Britain, for there are many details of orchard management and the handling of fruit which are regularly practised in the overseas Empire, which might with advantage be introduced to the notice of fruit growers in this country.

*[213. The proposed Imperial Horticultural Committee could render a valuable service by encouraging and arranging such visits.]

214. The Committee wish to put on record their appreciation of the action of the Empire Marketing Board in providing funds for an extension of research work on Root Stocks, Fruit Nutrition and Fruit Storage.

14.—Entomology.

215. *Quinquennial Conferences.*—In view of the importance of obtaining adequate representation of entomologists at the quinquennial conferences of entomologists of the Empire arranged by the Imperial Bureau of Entomology, this Committee very strongly recommend that each entomological service in the Empire should be represented by an entomologist at every such conference and that sufficient delegates should be sent from the larger entomological services to represent their various activities.

216. In order to secure better contact between entomological workers, especially in the case of those Dominions which have large entomological services, it is desirable that the periodical conferences of Empire entomologists should occasionally be held in Imperial centres other than London.

* Paragraph 213 was not adopted by the Conference.

217. *Travelling Fellowships.*—The Committee also feel that it would be desirable to establish travelling fellowships to enable entomologists engaged on special lines of investigation to visit other parts of the Empire in which similar problems are being studied.

218. *Biological Control of Insect Pests.*—The Committee, recognising the great importance of biological control of insect pests, desire to emphasize the necessity of paying more attention to this line of work, and also to the need of giving further assistance to the parasite work of the Imperial Bureau of Entomology, which would be complementary to work of this nature carried out by Governments of the Empire.

219. *Notification of Plant Pests within the Empire to the International Agricultural Institute.*—The Committee were advised that a number of Governments had received a request from the International Agricultural Institute at Rome for immediate notification of outbreaks of new pests in their territories. In the opinion of the Committee this would involve a duplication of work already done by the Imperial Bureau of Entomology, which affords adequate facilities in the Review of Applied Entomology for the publication of urgent information regarding outbreaks of injurious insects.

220. *Research and Teaching in Pure Entomology.*—In view of the fact that the progress of agricultural entomology is to a considerable extent dependent on the advancement of the science of entomology in general the Committee consider that it is very necessary that more attention should be given in Universities to research and teaching in pure entomology, which are at present hampered by the lack of the necessary funds.

15.—Insecticides and Fungicides.

(*Joint Report of the Committees on Entomology, Plant Pathology and Fruit.*)

221. The Committees on Entomology, Plant Pathology and Fruit jointly considered the paucity of materials in use as insecticides and fungicides, and their attention was drawn to the fact that certain of these materials could not be used without the risk of causing injury to the plants they were intended to protect. The need for a greatly extended chemical investigation of possible insecticides and fungicides was made clear, and the consequent need for more workers in this field, particularly chemists working in close touch with entomologists and plant pathologists, were emphasized.

222. The conclusions of the Committees are summarized in the following Resolution :—

> " That, in view of the great importance of insecticides and fungicides in the control of diseases and pests, and, in view of

the very limited number of substances now available for this purpose, and of their relative inefficiency, this Joint Meeting of members of the Entomology, Plant Pathology and Fruit Committees recommends that an investigation of the whole chemical field should be undertaken by chemists working in collaboration with entomologists and plant pathologists.

For such an investigation, new appointments would be necessary, since existing workers are already fully occupied."

16.—Preservation and Transport.

223. Preservation and transport are so closely woven into the whole fabric of agricultural production and distribution in the Empire, and as subjects for research offer so many possibilities, that the Committee in the short time at their disposal could not hope to do more than glance quite superficially over the field of enquiry.

224. Nevertheless, some not unprofitable discussions took place concerning actual problems, and so far as concerns the promotion of further intimate connections between Empire Bodies and the Low Temperature Research Station of the Department of Scientific and Industrial Research—at Cambridge—these meetings will, it is believed, prove to have been of real value.

225. *The Question of a Bureau.*—The Committee considered the question of the setting up of a clearing house for the interchange throughout the Empire of valuable information concerning their special subjects, and are of opinion that—

(i) a need exists for some machinery whereby Research Institutions* of the Empire may be kept abreast of progress in these special subjects ;

(ii) the most effective plan would be to entrust the distribution of information to a Research Institution engaged in studying these special subjects.

226. The Committee recommend, therefore, that an attempt should be made to ascertain and, if possible, to meet the full needs of those interested by initiating a scheme as follows :—

(*a*) Henceforth each Research Institution of the Empire to forward all its publications on the preservation and transport of food to the Low Temperature Research Station of the Department of Scientific and Industrial Research—at Cambridge.

(*b*) The Low Temperature Research Station to issue from time to time to the other Research Institutions of the Empire lists consisting of elaborated titles (not abstracts)† of

* This term embraces Research Centres, Scientific Institutions and Government Departments.

† The phrase "elaborated titles (not abstracts)" occurring in paragraph 226 (*b*) is intended to mean that while sufficient information would be given to indicate the particular part of the subject covered by a publication, experimental data and the like details would be omitted.

useful publications; the lists to include, so far as practicable, foreign publications.

(*c*) This scheme should be given a trial, and its operation reviewed after a reasonable period.

227. The Committee are of opinion that the time is not yet ripe for any organization with wider functions than this, and they would point out that the arrangements proposed are not intended in any way to remove the necessity for, but merely to supplement, those personal visits and individual correspondence which are ultimately far more important than an organized exchange of information on published matter. On this point the Committee were informed by Sir William Hardy that he and his staff at the Low Temperature Research Station are anxious to consider Empire problems and to meet and join with the members of other research institutions within the Empire in attempting to solve them.

228. *Fundamental Research.*—The Committee gathered that an impression exists that fundamental research in preservation and transport should be carried out by Great Britain alone, and that other parts of the Empire should confine themselves to the application of the results of such research to their local problems. The Committee definitely ascertained that this is not the view of the Department of Scientific and Industrial Research, and they regard it as of great importance that all parts of the Empire should undertake to the full extent of their means in men and material the solution of fundamental problems; the solution of many problems of this character can, indeed, only be attempted where the clinical material is available on the spot, e.g., sub-tropical fruit.

229. *Particular Problems Mentioned.* — Among the subjects mentioned in discussion were :—

(*a*) the development of a satisfactory process for the chilling of beef to enable it to last the voyage from Australia to England;

(*b*) effective preservation and transport by rail and sea of pineapples and sub-tropical fruit grown in South Africa;

(*c*) the devising of a system of bulk stowage on shipboard for the Canary bananas of Trinidad and the Windward Islands;

(*d*) the more effective preservation of grass and flax seed exported from Northern Ireland to New Zealand and vice versa.

230. Relations were established with the Low Temperature Station for further consideration of these particular problems, but beyond doing this the Committee do not feel it is their function specifically to recommend that research should be proceeded with in any one of them. Obviously there are economic and industrial considerations which would determine whether or not it is worth while spending time and public money on a specific research.

231. *Inspection of Cargoes.*—The Committee think it desirable to include in this report their views on the question which was raised as to the scientific, as distinct from the economic, inspection of cargoes from overseas on their arrival in this country. Hitherto the Department of Scientific and Industrial Research has accepted invitations from overseas Governments to undertake this work, but the Committee consider that such inspections will ultimately best be carried out by representatives of the country of origin of the cargo whenever it is possible to make such an arrangement. The Committee have ascertained that the Department of Scientific and Industrial Research would gladly lend any assistance that might be desired, such as, for example, by extending the hospitality of the Low Temperature Research Station to officers whom overseas Governments might desire to gain experience of the methods practised there.

17.—Agricultural Economics.

232. *Introduction.*—The Committee had before them the Report of a Committee on Agricultural Economics appointed by the Empire Marketing Board, and in the following Report they have based several of their recommendations on the conclusions set out in that Report. The preliminary work thus done has been of considerable value in defining the scope of agricultural economics, and in indicating the extent to which research is being carried on in different parts of the Empire.

233. *Importance of Agricultural Economics.*—The Committee are compelled to recognize that too little attention has hitherto been given in many portions of the Empire to research in agricultural economics. The Committee attach great importance to the systematic and continuous study of economic conditions as a means of promoting prosperity in Empire agriculture, and would impress upon the Governments of the Empire the need for securing the services of whole-time agricultural economists on the staffs of their Departments of Agriculture.

234. *Training of Workers.*—The Committee appreciate the value of the work already done by certain Departments of Agriculture and by individual investigators. Future developments, however, depend not only on official recognition of the need of this research, but on the supply of technically trained workers, of whom there is at present a serious dearth. This is a matter to which the Committee consider that the attention of Universities throughout the Empire should be directed.

235. *Interchange of Information.*—Both in initiating and developing research in agricultural economics throughout the Empire the need for the fullest possible interchange of information should be stressed. The subject of agricultural economics is not sufficiently developed to enable the Committee to suggest any single

information centre. *[The Committee recommend, however, that for the present the Agricultural Economics Research Institute, Oxford, should be recognized as a clearing house of information on matters connected with research in problems of production, and that similarly the Horace Plunkett Foundation should continue to serve as a clearing house of information on agricultural co-operation in the Empire.]

236. *Advisory Committee on Agricultural Economics.*—The Committee welcome the action of the Empire Marketing Board in setting up an Advisory Committee on Agricultural Economics for the purpose of fostering development and mutual assistance between different parts of the Empire in this subject. This Committee might serve in an advisory capacity to any Institution recognized as an information centre.

237. *Economics of Farm Production.*—There are two principal methods of investigation in this field :—

(*a*) *Cost Accounting.*—The Committee desire to emphasize the value of interchange of information between different parts of the Empire in regard to the technique of cost accounting.

(*b*) *Farm Surveys.*—The Committee are impressed with the valuable results which have been achieved from the development and the use of the method of farm surveys. While there are many parts of the Empire where costings investigations are virtually impossible on any large scale, the method of farm surveys is applicable in some form or other to all forms of agricultural production. The Committee, therefore, desire to lay special emphasis on the advantages of the farm survey method and recommend that steps should be taken to promote interchange of information and mutual assistance in this field.

238. *Economic Surveys.*—The Committee desire to emphasize the need for extending the survey method on a wider basis. The material collected by means of cost accounting and farm surveys should be designed not merely to help the individual farmer or serve purely local needs, but should be developed from a comparative point of view for national and inter-Imperial purposes. This material would usefully supplement the statistics now collected by public authorities, and should be brought together in such a way as to throw light on variations in costs of production and on the results obtained from different systems of farming. Economic surveys of this kind, combined with marketing studies, should provide valuable guidance in framing agricultural policies with particular reference to the development and settlement of new areas.

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* This part of paragraph 235 was not adopted by the Conference.

239. *Marketing.*—The Committee believe that the branch of agricultural economics which has in the past received the least systematic investigation is the study of marketing.

240. Among the chief objectives of marketing research are the abolition of waste and the lessening of price fluctuations. If these are to be achieved, continuous research is required both in the internal and external marketing of agricultural produce in each country.

241. Owing to the special importance of the United Kingdom market for the surplus agricultural produce of the Empire, marketing research in the United Kingdom provides special facilities and scope for inter-Imperial effort. This has already been recognized by the Governments of the Empire in appointing the Imperial Economic Committee to study the marketing and preparation for market of particular commodities selected by agreement among the Governments. Moreover, the British Government has provided machinery in the Empire Marketing Board for implementing specific recommendations of the Imperial Economic Committee designed to effect improvements in the machinery and methods of marketing. The Committee look to the continuance and development of organized research in marketing and the supply of market intelligence, both by official and unofficial agencies, as one of the most effective means of benefiting Empire agriculture.

242. *Collection of Statistics.*—The Committee desire to stress the need for the collection of more adequate agricultural statistics in the Empire. It is recognized that the collection of statistics is a matter of great difficulty in many parts of the Empire, especially in the less developed tropical areas. In fact many parts of the Colonial Empire have never carried out an Agricultural Census, and have not yet taken power to do so. The Committee feel, however, that it is of the utmost importance not only to the particular Colony, but to the Empire as a whole, that this deficiency should, wherever possible, be remedied.

243. *The World Agricultural Census of* 1930/31.—The Committee recommend that the attention of the Governments of the Empire should be drawn to the need of co-operating to the fullest possible extent in the project of the World Agricultural Census of 1930/31. They desire to point out that this Census affords a unique opportunity of collecting comprehensive statistics relating to Empire agriculture.

BLEDISLOE,
Chairman of the Imperial Agricultural Research Conference, 1927.

W. R. BLACK,
Secretary of the Conference,
10, Whitehall Place,
London, S.W.1.
November, 1927.

III. SUMMARY OF RECOMMENDATIONS.

(a)—Chain of Research Stations.

244. *Paragraph* 2.—The establishment of central tropical and sub-tropical research stations should be governed primarily by the ascertained needs of Empire research in particular fields of agriculture, rather than by considerations of geographical distribution. These stations should be located in territories affording specially advantageous conditions for the study of each problem. They should in the main confine themselves to " long range " and " wide range " research, a definition of which is given.

245. *Paragraphs* 3 *and* 4.—The work of the central research station should not impair or replace the scientific work of any Agricultural Department in its proximity. In providing advice it should limit itself to that directly resulting from its research activities; in special conditions it might serve as a convenient base of operations for a travelling advisory staff. No teaching work should be undertaken except in so far as the advanced instruction of a limited number of post-graduate students can be undertaken with advantage to the research work in progress.

246. *Paragraphs* 5 *to* 8.—A total superior staff of some ten highly qualified men will probably prove to be the minimum staff of a central research station. Besides adequate capital expenditure an annual maintenance expenditure of the order of £20,000 per annum must be envisaged. If there is no reasonable prospect of such staff and funds being provided the establishment of a station should be postponed. Contributions might be expected from both public and private sources, and besides money, might include gifts of land and in kind.

247. *Paragraph* 9.—The form of control of a central station must be such as to ensure that the work of the institution shall not be diverted from a programme of free research.

248. *Paragraphs* 10 *to* 16.—A programme of establishment of central stations is indicated. Most of these must eventually be in the Colonial territories. So far as these territories are concerned the development or modification of the programme is a matter primarily for the proposed Colonial Agricultural Research Council. The plan for a station in Northern Queensland is noted: the establishment of further stations in the self-governing parts of the Empire must be a matter for further consideration by the Governments concerned. The establishment of a central station for diseases of animals is of great importance, but presents difficulties. As a practical measure an existing station should be expanded for the purpose, and such expansion of Onderstepoort is suggested. The need for a central research station for irrigation problems should

be further explored; and a sub-committee of the Civil Research Committee could suitably be appointed to report upon the subject in its various aspects.

(b)—Bureaux and Interchange of Information.

249. *Paragraphs* 17 *to* 20.—The functions of an Imperial clearing station for the interchange of information are defined: for the present the organization of additional laboratories for attacking Imperial problems is considered to be outside these functions. Such stations are best established in conjunction with existing research institutions. They should be commenced in small numbers and on a modest scale.

250. *Paragraphs* 21 *and* 22.—The establishment of Imperial clearing stations on the scale of bureaux are recommended for *Soil Science* (at the Rothamsted Experimental Station), *Animal Nutrition* (at the Rowett Research Institute, Aberdeen), and *Animal Health* (in London). The last should include and absorb the section dealing with animal diseases now comprised in the Bureau of Hygiene and Tropical Diseases.

251. *Paragraph* 23.—The establishment of Imperial clearing stations on a smaller scale—"correspondence centres"—is recommended for *Animal Genetics* (at the Animal Breeding Research Department, Edinburgh University), *Agricultural Parasitology* (at the Institute of Agricultural Parasitology, London School of Hygiene and Tropical Medicine), *Plant Genetics* (at the Cambridge Plant Breeding Institute for plants other than herbage plants, the latter to be dealt with at the Welsh Plant Breeding Station), and *Fruit Production* (at the East Malling Research Station).

252. *Paragraphs* 25 *to* 28, 33 *and* 34.—The Imperial Institute and the Royal Botanic Gardens, Kew, should continue the useful work they are doing in acting as Imperial clearing stations in *Economic Botany* and also in other directions in the case of the former Institute. As regards *Dairying* it might be desirable to explore the best means of securing systematic collection and dissemination of information on the subject and, in this connection, the question of the publication of an Empire Journal on dairying research. On *Preservation and Transport* the Low Temperature Research Station should undertake the duty of arranging for the interchange of lists of new and useful publications in those subjects. The establishment of a single publicity bureau for the Empire is not recommended nor is a central clearing station for work other than that specified for the Imperial bureaux and correspondence centres.

253. *Paragraphs* 29 *and* 30.—The funds of the new Imperial bureaux and correspondence centres should be administered by an authority on which the Governments of the Dominions and India and certain Government Departments in the Mother Country should

be represented. In addition each bureau should be advised by a technical committee nominated by the Governments concerned and reporting to the financial supervisory body ; correspondence centres should, as far as practicable, also be conducted on these lines.

254. *Paragraph* 32.—Uniformity in methods of indexing, recording and publication should be secured by bureaux and correspondence centres.

255. *Paragraphs* 35 *and* 36.—The " List of Agricultural Research Workers in the Empire " should be revised and periodically circulated. The general survey of " Agricultural Research in the Empire " should be revised on the occasion of the next Conference.

256. *Paragraph* 37.—The Conference will meet again in Australia in 1932. Specialist and regional conferences are desirable : the initiative in convening them should be left to the authorities immediately concerned.

257. *Paragraphs* 38 *and* 39.—The sums of £13,000 for Imperial bureaux and £7,000 for correspondence centres in all, per annum, for five years in the first instance, should be sufficient for the programme outlined.

(c)—Recruitment, Training and Interchange of Workers.

Part A.

I. *The Standards and Requirements of a Colonial Agricultural Service.*

258. *Paragraph* 45.—Agricultural advancement demands that every effort should be made to attract candidates of the highest class and to equip them with the best possible training.

259. *Paragraphs* 46 *to* 48.—For the specialist officer a sound honours training in the pure sciences, including at least one biological subject, is essential. Equally essential is such a knowledge of agriculture as will enable him to appreciate clearly the role of science in agriculture.

260. *Paragraphs* 49 *and* 50.—For the agricultural officer wide agricultural knowledge, a practical outlook and administrative ability constitute the first requirement. The second is scientific knowledge adequate for the full utilization of scientific results in agriculture and for close collaboration with his specialist colleagues.

261. Character and health are of first importance.

II. *Recruitment for a Colonial Agricultural Service.*

262. *Paragraph* 52.—Adequate emoluments, facilities for work, and satisfactory superannuation arrangements are necessary in the interests of recruitment as well as for the ultimate efficiency of the Service.

263. *Paragraph* 54.—The nature, amenities and prospects of the Service must be made more clearly and more widely known.

264. *Paragraphs* 56 *and* 57.—Scholarships to boys still at school are not recommended. School-leaving scholarships to the Universities should be considered.

265. *Paragraph* 58.—Inducement in the form of scholarships of any kind is wise and fair only if the Service be made to provide really good careers.

266. *Paragraph* 60.—A flourishing agriculture throughout the Empire is the best guarantee of a market for Empire manufactures. It is, therefore, suggested that the founding of scholarship schemes to promote agriculture deserves the attention of all industries, agricultural and other.

267. *Paragraphs* 63 *and* 64.—The predominance of the physical sciences over the biological sciences in all educational institutions from the elementary schools to the Universities is one of the gravest difficulties in the supply of officers for the agricultural service. It is essential to view this difficulty as one of education as a whole, not merely of agricultural education. The help of educational authorities should be sought without delay.

III. *The Colonial Office Agricultural Scholarship Scheme.*

268. *Paragraphs* 65 *to* 70.—The existing scheme, strengthened and suitably modified, may be expected to meet requirements for the present, provided that it be extended to cover Veterinary Science.

269. *Paragraph* 68.—The scholarship scheme will be greatly facilitated if Colonial Governments supply advance warning of their staff requirements.

IV. *The Training of Colonial Office Agricultural Scholars.*

270. *Paragraph* 72.—The broad object of post graduate training is to develop the scholar (qualified as in III) into the officer (qualified as in I).

271. *Paragraphs* 73 *to* 75.—Systematic training courses cannot be prescribed. It must be left to the Universities and Colleges to ensure that scholars have every opportunity to profit from instructional facilities and to develop themselves to the standard desired in the Service (I above). Every possible step must be taken to free from unnecessary difficulties the share of Universities in training scholars.

272. *Paragraphs* 78 *and* 74.—Training should include some investigational work and scholars should, whenever possible, be under a Supervisor, himself engaged in investigation and with experience of teaching.

273. *Paragraphs* 72 *and* 77.—The training should continue to be normally one year in Great Britain and one in a tropical country, e.g., at the Imperial College of Tropical Agriculture, Trinidad. Careful co-ordination of the work in these separate years should be effected.

274. *Paragraph* 76.—Short specialist courses should be avoided and soundness in fundamentals be the first aim.

275. *Paragraph* 80.—Provisions for training must be flexible, and the personal interest and services of the body administering the scheme for scholarships and training are the real guarantee of success.

PART B.

V. *An Imperial Basis for Recruitment and Training.*

276. *Paragraph* 81.—Scholarships and post-graduate training on an Imperial basis are impracticable.

277. *Paragraph* 82.—Scholarships and appointments to the Colonial Agricultural Service are, it is learnt with pleasure, already open, in practice, to suitable men from all parts of the Empire.

278. *Paragraphs* 83 *to* 85. The stimulation of further interest in, and recognition of, the importance of science in agricultural development should again be urged upon all the Governments of the Empire.

VI. *Study Leave.*

279. *Paragraph* 87.—Facilities for study-leave are essential to the success of an agricultural service.

280. Existing facilities are, in general, inadequate. Specific financial provision and appropriate increases in staff to make study leave possible are an urgent necessity.

281. *Paragraph* 90.—Study leave should always have a specific object and be planned with great care for the sake of both the officer and the institution he visits.

282. *Paragraph* 92.—No central agency is necessary for study leave arrangements. The bureaux and correspondence centres should be able to facilitate appropriate connections and arrangements.

VII. *Interchange of Workers.*

283. *Paragraph* 94.—Routine interchange is deprecated. Beneficial interchanges will suggest themselves.

284. Interchange would bring many benefits, some of which would reach beyond the strict limits of agricultural progress.

285. *Paragraph* 95.—Throughout the Empire existing facilities are inadequate mainly because of financial difficulties. The help of the appropriate authorities should be sought for this powerful aid to Imperial agriculture.

(d)—Veterinary Science.

286. *Paragraphs* 97 *and* 98.—The Conference afforded a unique opportunity for the exchange of ideas between veterinary science workers, from which great benefit was derived.

287. *Paragraphs* 99 *to* 112.—There is need for a clearing house of information on this subject. Existing facilities are inadequate. A Bureau of Animal Health is proposed to deal with State veterinary hygiene and medicine, including legislative measures for the control of animal diseases. The objects of the bureau are stated in paragraph 111. The headquarters should be in London. It should incorporate the veterinary activities of the existing Bureau of Hygiene and Tropical Diseases. Recommendations as to organization and finance were not adopted by the Conference.

288. *Paragraphs* 115 *to* 118.—Various concessions as regards training are made in different parts of the Empire to students of other sciences who pass over to veterinary training. Adequate specialized professional training cannot be accomplished in less than three years. Every effort should be made to encourage veterinary students to take University degrees, and undergraduate scholarships for the purpose are recommended.

(e)—Animal Nutrition.

289. *Paragraphs* 119 *to* 124.—A Bureau for Animal Nutrition should be established at the Rowett Institute: its functions are defined. Recommendations as to organization and finance were not adopted by the Conference.

(f)—Animal Genetics.

290. *Paragraphs* 126 *and* 127.—There is need for further research in animal genetics. The work at Cambridge and Edinburgh on the physiology of reproduction should be developed; the formation of active centres of research in animal physiology throughout the Empire should be encouraged.

291. *Paragraphs* 129 *and* 130.—Those concerned with livestock breeding and improvement should be given an understanding of genetics. Veterinary officers of the tropical and sub-tropical Colonies and the animal husbandry and livestock specialists of the Dominions should be equipped with an advanced knowledge of this subject.

292. *Paragraphs* 131 *to* 133.—The Animal Breeding Research Department of Edinburgh University should be regarded as the centre for training in animal genetics. The facilities of that Department should be amplified and developed. The Governments of the Dominions and India and the Colonial Office should increase the number of post-graduate fellowships which would enable suitable men to come to that centre.

293. *Paragraphs* 134 *to* 136.—That Department should also serve as an information centre in this subject. The functions of such centre are defined. Recommendations as to finance were not adopted by the Conference.

(g)—Dairying.

294. *Paragraphs* 138 *and* 139.—Further study is required of nutritional and breeding problems, and of the physiology of milk production. Systematic investigation of the economics of dairy production is of importance. The Empire Governments should encourage the study of the problem of effecting improvements in the flavour, carrying quality, &c., of Empire dairy produce imported into Britain.

295. *Paragraph* 140.—Greater uniformity should be established throughout the Empire in the official specifications prescribed for volumetric glassware used in testing milk and milk products.

296. *Paragraphs* 141 *to* 143.—The importance of interchange of dairy research workers is stressed.

297. *Paragraph* 144.—An Empire journal of dairy research is suggested. A recommendation for the formation of an Empire Dairy Research Committee was not adopted by the Conference.

(h)—Soils and Fertilizers.

298. *Paragraphs* 146 *to* 149.—The need for a Soil Bureau is indicated, and its functions are defined. The bureau should be located at Rothamsted Experimental Station. Recommendations on control and finance were not adopted by the Conference.

299. *Paragraphs* 151 *to* 153.—A memorandum on soil classification has been drawn up which should be passed to the bureau when established. Recommendations are made as to mechanical analysis of soil: methods should be studied by the bureau.

300. *Paragraph* 154.—A memorandum on principles fundamental to fertilizer trials has been drawn up which should be passed to the new bureau.

301. *Paragraph* 155.—Memoranda on soil deterioration resulting from shifting cultivation, disafforestation, &c., are being drawn up and should be passed to the new bureau for study.

(j)—Plant Breeding.

302. *Paragraphs* 156 *to* 162.—An information organization for plant breeding is recommended, and its functions are defined. The Cambridge Plant Breeding Institute is suggested as a suitable centre for crops in general, and the Welsh Plant Breeding Station for herbage plants. Recommendations on control and finance were not adopted by the Conference.

(k)—Plant Pathology.

303. *Paragraph* 163.—Reports already supplied to the International Agricultural Institute meet the requirements of that Institute for official information concerning plant diseases within the Empire.

304. *Paragraph* 164.—Lists of plant diseases should be prepared by Governments of the Empire. The Imperial Bureau of Mycology should publish and distribute such lists.

305. *Paragraph* 165.—The attention of Empire mycologists is called to the preparation by the British Mycological Society of a list of common and scientific names of plant diseases with a view to uniformity in nomenclature. The list should be circulated to Governments.

306. *Paragraph* 166.—The Imperial Bureau of Mycology should prepare a list of books and periodicals to be regarded as the minimum requirement for a Government mycologist : a copy of the list should be forwarded to Departments concerned.

307. *Paragraph* 167.—The Imperial Bureau of Mycology should draw up a list of institutions to whom the papers and bulletins on Mycology and Plant Pathology published officially should be supplied by Governments.

308. *Paragraph* 168.—Funds should be provided for the more extended study of the fundamental nature of virus diseases in plants.

(l)—Fruit.

309. *Paragraphs* 169 *to* 181.—The interval between the planting of fruit trees and the time when they come into bearing is so great that the losses consequent on mistakes at an early stage are extremely serious to the horticulturist.

310. *Paragraphs* 183 *to* 189.—The most pressing questions needing research are those relating to the orchard in its early stages, the most important being : (*a*) The study of stock and scion and their interrelations ; (*b*) Surveys of fruit areas to determine the relation of various factors to tree growth and fruitfulness ; (*c*) Chemical studies relating to the tree and its crop ; (*d*) The associated physiological studies.

311. *Paragraphs* 191 *to* 196.—Other questions of importance are the utilization of low grade fruit, the preservation and transport of fruit, and especially the control of diseases and pests. The provision of a suitable centre for research and advisory work on fruit preservation and by-products is urged.

312. *Paragraphs* 198 *to* 209.—A recommendation for the formation of an Imperial Horticultural Committee in Great Britain, with Information and Publication Sub-Committees was not adopted by the Conference.

313. *Paragraphs* 210 *to* 212.—Facilities should be granted for horticultural research workers in the various countries to visit other parts of the Empire.

(m)—Entomology.

314. *Paragraphs* 215 *and* 216.—At the quinquennial Imperial Conferences of entomologists each entomological service of the Empire should be represented by at least one entomologist. These conferences should occasionally be held at centres other than London

315. *Paragraph* 217.—Travelling fellowships for entomologists should be established.

316. *Paragraph* 218.—More attention should be paid to the biological control of insect pests. The work of the Imperial Bureau of Entomology in this direction should be further aided.

317. *Paragraph* 219.—The information published in the Review of Applied Entomology meets the requirements of the International Agricultural Institute for information concerning outbreaks of new pests in the Empire.

318. *Paragraph* 220.—More attention should be given in Universities to research and teaching in pure entomology.

(n)—Insecticides and Fungicides.

319. *Paragraph* 222.—A chemical investigation of insecticides and fungicides should be undertaken by chemists working in collaboration with entomologists and plant pathologists.

(o)—Preservation and Transport.

320. *Paragraphs* 225 *to* 227.—The time is not ripe for the establishment and development of a clearing house for the interchange throughout the Empire of information concerning research into the preservation and transport of agricultural products. Machinery should, however, be set up at the Low Temperature Research Station for the interchange of lists of new and useful publications. It is separately desirable to promote the direct reference of problems preferably by personal conference and collaboration.

321. *Paragraphs* 228 *and* 229.—All parts of the Empire should undertake the solution of fundamental problems of preservation and transport. Various problems are mentioned.

322. *Paragraph* 231.—Scientific inspection of overseas cargoes on arrival in this country should be carried out by representatives of the country of origin whenever possible.

(p)—Agricultural Economics.

323. *Paragraph* 233.—The importance of the study of economic conditions is stressed as well as the need for Governments of the Empire to secure the services of whole-time agricultural economists on the staffs of their Departments of Agriculture.

324. *Paragraph* 234.—The attention of Universities throughout the Empire should be drawn to the dearth of technically trained workers in this subject.

325. *Paragraph* 235.—Recommendations as to the establishment of centres of information were not adopted by the Conference.

326. *Paragraphs* 237 *and* 238.—Interchange of information should take place on the technique of cost accounting and methods of farm surveys. Material collected by the two methods of work should serve national and inter-Imperial purposes as well as local needs. Examples of such purposes are given.

327. *Paragraphs* 239 *to* 241.—The continuance and development of organized research in marketing, and the supply of market intelligence is one of the most effective means of benefiting Empire agriculture.

328. *Paragraphs* 242 *and* 243.—Adequate agricultural statistics should be collected throughout the Empire. The World Agricultural Census of 1930/31 affords a unique opportunity of collecting such statistics.

IV. SUMMARY OF PROCEEDINGS.

1.—Opening of Conference by the Rt. Hon. Walter Guinness, M.P., Minister of Agriculture and Fisheries.

Tuesday, October 4th, 1927.

Before the Conference starts upon its labours, it is my privilege on behalf of His Majesty's Government to say a word of welcome to the delegates who have come from all over the Empire to attend. We have had very many conferences on agriculture. We have had international conferences, we have had sectional conferences to discuss one side of agricultural matters, and we have had local conferences, bringing in all sides in a particular area, but never before have we had a conference for the research workers in agriculture from the whole Empire. Never before have the knowledge and the experience of the Empire been invited to come together to take common counsel about the development of our greatest Imperial industry, and to seek for common measures for improvement.

The first definite suggestion that this Conference should be held came, I believe, some two years ago from Sir John Russell at the Ministry's Research Council. The Ministry explored and developed the proposal, and it was cordially endorsed by the Imperial Conference of Prime Ministers last year, who saw in it a wonderful opportunity of assisting the great cause of Empire development. We have had invaluable support, too, from the Empire Marketing Board, support not only of a moral kind, but also the most valuable form of support in the matter of finance.

The delegates are all very busy people, and I know it has involved a great sacrifice to them, and sometimes I suppose to their particular work, to make the long journeys and spare the considerable time which this Conference will entail; but it has been realized how important it is that we should take counsel together.

Agriculture is by far the largest of our Empire industries. In this crowded island we have been driven into urban and industrial development, yet even here the agricultural output of England and Wales alone reaches the great annual sum of £225,000,000; but when you look beyond our shores, and come to the vast overseas areas in the Dominions and Crown Colonies, where 80 per cent. of the population are living by agriculture, you realize what a giant pillar of our Imperial life and prosperity this industry must always be.

We have realized that agriculture cannot prosper without research

The foundations of agricultural science were laid long before Governments took any part. I think it is a matter really of some reproach to Governments that they were so late in the field. The foundations were laid by men who pursued pure research for the love of knowledge, and no doubt great results will still continue to be reached by those who desire to learn the secrets of nature without any thought to practical application. But though we all know the natural fear of too much pressure upon research workers to apply their results, I am sure you will recognize that we are bound to try and harness the results of agricultural research to the service of the economic needs of mankind.

We are living in times of change and of growing complexity, and any science or any industry that is content to stand still is very quickly left behind. We cannot be content merely with keeping our relative position in agriculture among other industries. The workers in our industries are rightly demanding better standards of living, a wider horizon, and it is only by the increase of efficiency of our agriculture and the return which it gives to us that we can hope to satisfy their demands.

It is mainly by research that we can hope to achieve the advance. The past triumphs of research are familiar to everyone in this room. I need only mention the discovery of artificial fertilizers, the application of Mendel's principles of heredity in animal and plant breeding, and the great work which we associate with Sir Arnold Theiler's name in South Africa to show what great influence science has already had on the economic position of the industry.

Sir John Russell told the Agricultural Section of the British Association in Toronto three years ago something of further possibilities. He pointed out that at present the efficiency of even our best crops as transformers of the sun's energy is something like 1 per cent.—very far behind the worst motor car engine. Our human conditions would be transformed if we could add appreciably to the return which the soil gives to human labour by the efficiency of the crops in this direction, and hopeful results are also looked for from the control and taming of the vast population of micro-organisms of the soil to the human end. It is a new science. The knowledge which has yet been achieved is comparatively in its early stages, but already there have been three very wonderful applications in the inoculation of leguminous plants, in the conversion of straw by artificial means into valuable manure, and in the increases of fertility which have been brought about by partial soil sterilization.

All these researches depend upon team work. The sum of scientific knowledge is so vast that it is more than ever difficult for the lonely worker to reach his end; more than ever long and patient preparation is necessary to-day to achieve results, and it

is only by this preparation that the flashes of discovery can be brought about. The Empire presents the widest possible problems. We have the most varied conditions of agriculture of any State in the world. We have greater need of trained men to explore those problems, and that is a matter to which this Conference will, I hope, give its attention.

It may perhaps seem sometimes rather surprising that those who are concerned with the pastures and cornfields of the temperate zone can have any common interests in research with those who are tackling the problems of rubber production in Malaya or sugar production in the West Indies. But we know that the fundamental principles of agriculture are the same the whole world over, and men from the Tropics have for years past been coming to Cambridge and to Rothamsted, learning the results which have been achieved there, and taking them back to try and apply them to their peculiar tropical problem. On your agenda there is a question of setting up a chain of Imperial Research Stations, and I hope we may be able to introduce an alternating current, and not only have research workers coming to this country from other parts of the Dominions, but also develop the possibilities for our workers to go out and get fresh views and new ideas in other climates.

I need not perhaps dwell on the great reward which we may expect from co-operation; I need perhaps only mention one instance, the researches which are now going on into the mineral content of natural pasture. Here we have work going on at Aberdeen, and it is linked up with researches in New Zealand, Kenya and Australia.

Apart from organized co-operation in any particular direction, the Conference will have to consider how best to ensure a proper diffusion of knowledge throughout the Empire on researches which are taking place, how to ensure that results which have once been reached are not forgotten. I remember reading a very startling instance in some report of my friend, Mr. Ormsby-Gore, an instance which he met with on one of his Empire tours (and it was a very startling instance, which remained in my mind) of a valuable piece of work done in a particular Colony which was absolutely unknown outside the Colony, and had actually been forgotten in the Colony where it had been achieved. We really must try and prevent that kind of thing happening in the future.

The bulk of scientific literature is so vast that to the ignorant layman it is one of the most marvellous achievements of the man of science that he is able to cope with it. I am overwhelmed by the quantity of literature that this Conference has produced even before it has met, and when you consider that agricultural science is a complex of many other sciences, the problem of finding some clearing house for knowledge becomes very urgent. I do not know how this Conference will solve it, whether by an extension of the

system of Imperial Bureaux, which have given us such valuable results in the case of Mycology and Entomology, but I am sure that whatever system of working they find, it will be invaluable to the cause of agricultural science. We really must solve this question and ensure that agricultural science is not buried under the lead of its own print. Great Britain is most anxious to help in every way, and we know by the response which the invitation to this Conference has evoked that you too in all your different areas are anxious to help.

Although we in Great Britain are not an agricultural community in the same sense that the Dominions and Crown Colonies are, we have a very active organization which is the creation, I may say, almost of one man, Sir Daniel Hall, and a great deal of its development has taken place within the last eight years. Though we should like to have a larger organization, it is, I think, the most complete which exists in the Empire ; you will have an opportunity of judging its efficiency on the spot, and I hope when you have seen it you will agree that there is really no need to seek a Mecca of agricultural research outside the British Empire.

Our organization is, of course, small and modestly equipped in comparison with the organization which exists in the United States of America. We have not the money to spend on these objects in the way that they have on the other side of the Atlantic ; but, although we cannot compete with them in the scale of our expenditure and the number of workers, we do say that we have a very live system in this country, and that it has the requirement of all science, the spirit, which means the life.

I am not going to deal any further with the problems which you will tackle in your discussions. The idea which runs through the whole of our agenda is the idea of mutual help. The object of your presence to-day is to secure that on the ocean of agricultural research no man shall voyage alone if a fellow traveller can be found by whose past experience or present companionship he may be guided and inspired. On that sea of research all workers are fellow travellers, whether in Great Britain, Canada, Australia, New Zealand, the West Indies, or the Far East, and the great object of this Conference which meets to-day is to find out how we best can help one another.

The Organizing Committee who have given a great deal of attention to the arrangements for the Conference have recommended that Lord Bledisloe, who was Chairman of that Committee, should be the Chairman of the Conference. I have little doubt that that proposal will commend itself to the Conference, and so, if I may assume your approval, I will now ask Lord Bledisloe to take the Chair.

2.—Opening Speech by the Chairman, The Rt. Hon. Lord Bledisloe, K.B.E., Parliamentary Secretary, Ministry of Agriculture and Fisheries.

Tuesday, October 4th, 1927.

I very highly appreciate the honour which you have conferred upon me in appointing me your Chairman. The Minister of Agriculture has in a most eloquent speech emphasized the immeasurable importance of the problems which will come under your survey and has indicated the uniqueness of this Conference and its personnel, representing as it does the Dominions, India, the Crown Colonies, the Mandated Territories and other countries with which, for governmental purposes, this country is closely associated. I need hardly remind you that there are here representatives of lands as far distant from each other as New Zealand, Malaya, Mauritius and the Leeward Islands. That will give you some small indication of the far-flung character of this Conference.

Now, may I personally outline what I conceive to be the justification and the main objects of this Conference, and perhaps you will forgive me if I find myself repeating something at least of what the Minister of Agriculture has said in his speech. It is eminently desirable and, as many of us think, essential, that the British Empire should secure as its basis a self-contained supply of food and of industrial raw material, not merely adequate for its present needs, but capable of sustaining its growing population. Now, in order to effect this, the current production from the soil must be intensified ; it must not merely be extended into new areas but must be augmented on the existing area of cultivation. Such intensification, as I am sure you will all admit, can only be accomplished by research on the one hand and education on the other, if the costs of production are not to rise inordinately and if the so-called law of diminishing returns is not to operate adversely.

The need for closer communication between agricultural scientists and administrators of the Empire has for a long time been felt. The Minister acknowledged just now that a special impetus was given to this Conference some two years ago, but I cannot help remembering that a meeting over which I had myself the honour to preside at Australia House during the Imperial Education Conference of 1919, discussed the urgent importance of co-ordinating agricultural research throughout the Empire and of establishing a clearing house for the dissemination of ascertained results of proved economic value. This was followed by the interchange of views between various Government Departments and the actual drafting of a scheme for an Imperial agricultural bureau, as it was called, which, however, was put on one side owing to the imperative demand for economy.

I am now going to venture to say something on the subject of economy in this connection. There are necessarily conflicting views as to what constitutes true economy. I note, for instance, with interest and considerable personal sympathy, the following striking paragraph in the report of the Research Committee of the Imperial Conference of last year. In advocating a settled policy regarding the application of research to development they say this :—

> " It may be urged that owing to financial stringency it is unwise to embark upon such a policy. The Committee do not agree ; on the contrary they consider that the poorer a country is the greater its need to develop and employ its scientific resources to the fullest extent. This is particularly true for the British Empire with its enormous potential resources which cannot be fully developed without the aid of science. Germany in the 19th Century provided a classic instance of the way in which a comparatively poor country can, by the organized application of scientific research, immensely increase its wealth and power and rapidly overhaul neighbouring nations possessed of greater natural advantages."

Fortunately, the Imperial sense, if I may so call it, has of late years been steadily growing, as has also the realization of the fundamental importance of agriculture and the pressing need for agricultural research, not only in the field of chemistry such as was deemed adequate for its successful conduct in the days of Liebig, Boussingault and even Lawes of Rothamsted, but in several different sciences, such as physics, entomology, mycology, genetics, animal pathology and last, but not least, economics, the operation of whose respective laws clearly affects the productivity of the farmer's business. Hence this Conference.

Now, the word " research " is apt to be used somewhat loosely, and it is important, if I may venture to say so, in this Conference, that we should keep steadily in mind the clear distinction between research proper on the one hand and what I may call its second stage, viz., the practical and administrative work which for its full justification must grow out of it.

Research, in its strict significance, consists in the pursuit of precise knowledge and is the function of experts working unfettered in comparative seclusion with a permanent establishment of laboratories and experimental grounds behind them. But as with agriculture itself, so with regard to knowledge, distribution is almost as important as production. Every Government requires a corps of administrators and teachers, veterinarians, biologists, physicists and chemists translating research into practice. This Conference cannot effect much as regards actual research. It can, no doubt, survey the field and say what is needed in the way of primary institutes where fundamental work is being pursued.

We, I may say, are not a little proud in this connection of the organization which has been built up in the British Isles during the last 20 years and, as the Minister of Agriculture has indicated, through the efforts of Sir Daniel Hall, the Chief Scientific Adviser to the Ministry of Agriculture in this country ; and this in spite of the very great difficulties occasioned by the war. We want to show you our research institutes so that you may realize the opportunity which, as we think, they offer for developing co-operative work in conjunction with similar institutes overseas. Doubtless the distribution and exchange of results obtained at such institutes are in the main provided for by the recognized scientific journals, and the actual investigators in any particular subject find but little difficulty in getting in touch with one another ; but as a memorandum which I notice we have received from South Africa, so wisely says : " Knowledge obtained by means of books "—and, I may almost add, by means of correspondence—" can never be as convincing as that gained by personal observation." " After all "—it says—" the personal touch is the impelling force in human nature."

It will be worth while to discuss here such questions as the establishment of further Imperial bureaux, the recruitment and interchange of workers, refresher courses for those working in the outlying parts of the Empire, and the organization of occasional flying corps to attack special problems far away from the research centres.

This Conference will, it is hoped, ensure fuller co-operation between the staffs of all our institutes than has hitherto been possible, and thus lead to considerable economy in both time and money and a very marked improvement in the efficiency of the work. As the Minister has indicated, we have splendid team work going on within the walls of many of our research institutes. What we now require is similar team work as between the institutes themselves scattered throughout the Empire, and, as the Minister said just now, in spite of the great variety of physical conditions in different parts of the world, we have to recognize that the principles underlying scientific agriculture are everywhere the same. It is only their application and their relative importance in any particular set of conditions that appreciably vary. Economy of effort is absolutely essential and, therefore, while discussing the means of ensuring independent examination of fundamental work, we must, if we can, avoid unnecessary duplication.

It is, however, the second stage, that of administration and application, which requires, at least at this juncture, whatever may happen at future conferences, the fuller consideration in this Conference. The need is everywhere felt of a better exchange of information regarding the practical methods of applying research —examples of successful administration and types of regulation which are proving locally effective. At present, for example, if

a new disease of the sugar-cane or of the cotton plant is threatening the prosperity of that particular industry, the scientific aspect of the case, such as its diagnosis and life history, may get worked out and published in a standard journal which reaches all other specialists in plant diseases, but the practical methods by which the disease has been kept in check in any particular Dominion or Colony, the mode of administrative control which is proving effective, may easily be buried in a different publication confined to that part only of the British Empire.

What organization, we shall ask ourselves at this Conference, can be set up which will ensure the distribution of such knowledge expressed in language intelligible to those who can easily take advantage of it. The method of bureaux has already had great success in the case of the Imperial Bureaux of Entomology and Mycology. This method, however, I would venture to suggest, seems only suitable where there is a local corps of officers with advisory and administrative functions who constitute the clientele of the bureau and who correspond with it: the bureau organisation seems less suitable to deal with such subjects as animal husbandry which are wider and more various in their scope, less amenable to administrative treatment and are handled by practical men rather than by officials. But it would be desirable to explore what can be done in such cases in order to provide a clearing house for enquiry and information, including especially a journal indicating relevant informative publications, if only their titles are given.

It will probably also be thought desirable to organize periodical conferences at quinquennial or other fixed intervals. While our deliberations will be primarily concerned with organization and administration, it is proposed to form specialist committees to which technical subjects of outstanding importance can be referred for consideration and subsequent report to this Conference. An interval, as you will have noticed from your Agenda, between our Plenary Sessions is going to be provided for this purpose next week before we proceed to Cambridge.

3.—Recruitment, Training and Interchange of Workers.

Wednesday, October 5th, 1927.

Lord Lovat (Parliamentary Secretary for the Dominions): The Report of the Research Sub-Committee of the Imperial Conference, on Man Power, is before you, and it would be a waste of your time if as Chairman of that Sub-Committee I tried to elaborate that Report at any length, and I think I would serve a more useful purpose if I pointed out some of those questions which either the Man Power Committee had not time to go into or which it thought were too controversial to be dealt with at any length in a general Imperial Conference.

As regards recruitment, it was borne in on us most clearly, both on that Sub-Committee and on other Sub-Committees which have been held at the Colonial Office, that there is a real shortage of suitable candidates for research work. Whatever palliatives are put forward—(some of which are mentioned in Agenda Memorandum No. I* on this subject)—from the evidence I have heard on the various Committees on which I have sat, I have no doubt that until the Agricultural Research Service, in pay, status, career and rewards, is equal to other Government Services carrying equal duties and responsibilities, nothing final and definite will be done. In some of the Services considerable advances have been made, especially in the lower grades, but until there are definite and certain prizes at the top, there will not be attracted into the Service from the Universities the best type of candidate, the man of first-rate quality, that is wanted more than ever now. We have had that point so clearly borne in on us not only by those who are serving, who naturally speak with a certain interest in the matter, but also by the centres of learning from which these young men are produced, that I have no hesitation in making this as a very clear and definite statement.

It will always take time to get through reforms, and it will take further time, even when those reforms are through, for the facts to be known by parents who may be sending their sons into the Agricultural Services, and by the Universities. It is, therefore, necessary to consider very closely those perhaps temporary measures —some of them may have to be permanent measures—such as scholarships, which not only fill in the gap until the prizes, which we hope will be made in the future, are created, but which also assist those parents who are unable to give their sons the full training qualifying for research. Probably about six years' training are needed before a man can become a full-fledged member of an Agri-

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* See Appendix B, p. 221.

cultural Research Service, and many parents are unable to see the whole of that period through without outside aid.

The principal groups of scholarships in Great Britain, which have been created in the last few years—I refer, of course, to those of the Empire Cotton Growing Corporation and the Colonial Service—have certainly attracted, as far as we can learn from the Universities, increasing attention from the young men there, and a better class of candidate has come forward recently. Any Imperial scholarship scheme will, I am sure, be regarded here with the greatest interest. Whether it is workable in point of fact your Committees who will sit on the question will in time show. The Committee on Agricultural Research in the non-self-governing Dependencies, made the following recommendation to the Secretary of State for the Colonies :—

> "We consider the work of Colonial Agricultural Departments to be so important that their staffs should be recruited from the best material available in the Empire. We, therefore, recommend that overseas students should be eligible for scholarships, provided you find it possible to make arrangements which, in the absence of interviews in this country, will enable you to judge whether they are fully up to the standard required and satisfactorily compare in their qualifications, personal and academic, with candidates from this country."

Whether or not it is found possible to make an Imperial scholarship scheme, scholarship schemes should be as numerous as possible in order to make a large pool. In the first place the larger the pool the more likely the fisher from the particular agricultural department will be to extract the fish that he requires. In the second place a large pool equalizes Government demands. It is very difficult for a Government to say five years ahead what is going to be its agricultural requirements : timely notice of requirements should be given by Governments. The third point is that private and corporate bodies are, more and more, stealing some of the best men. It is only fair that they should enter into Scholarship Schemes and make a pool rather than take the ready-made products from the services which can least afford to lose them. The Empire Cotton Corporation has given a magnificent lead in this matter. There are other Corporations and also public companies which should follow that lead. It is not looking too far ahead to envisage the time when the Imperial Chemicals Combine—one of the biggest associations which exist—will have their research stations alongside our chain of research stations for the Empire. Is it not right that they should join in Scholarship Schemes so as to give a larger pool from which to get their men ? Other bodies should in the same way join in carrying out their part in training research workers for the needs of the Empire.

Passing from scholarships to the question of whether it is advisable that we should attempt to ear-mark boys at the Public and Secondary Schools before reaching Universities, I would submit that it is well worth discussing whether in those services for which either recruits are required or which have not yet received public recognition of their importance—I mention two, mycology and veterinary science—boys possessing power of leadership, keenness, and traditions of service might be selected under proper conditions and assisted perhaps in their last years at school and their first years at the University, with a portion of their expenses and a definite promise given them of future engagements, and thus the minimum of loss occasioned during the transit of these boys through their training period and before they join some service. We have heard of the extreme difficulty of securing the mycologists that are required in the Empire, and it might be possible in that way to get hold of more recruits. Again, there is no position which requires greater powers of leadership than that of the veterinary officer in an up-country station administering what are, particularly to the native mind, the hurtful laws respecting cattle. Such service has not yet been popularized and shown in its true light to the general public.

Passing from the question of recruiting to that of training, all the Committees with which I have worked have considered that the training for the specialist officer must be an honours degree in pure science, and that vocational training should be post-graduate, with a background of scientific interest and a foreground of economic interest.

On the question of refresher courses: while they have been recommended by many Committees, the actual practical details have not been sufficiently worked out, and this is a matter which the Conference might study with advantage. While the majority of officers who come home wish to make themselves up to date in laboratory technique, which can be easily and simply done, there are many who wish to take special courses and special studies at centres where their particular subject is under investigation on a larger scale than in their own Dominion or Colony.

Three facts are important in this connection. First, the importance of the service must be sufficient to make study of a reasonable length of time possible. It has been stated several times—I am speaking more particularly of the Colonial Territories—that study might have been undertaken but that it was impossible to release the men from the work they were doing. There must, secondly, be some organization overseas which communicates with a central body to give due notice of the courses that are required: this notice is often so short that it is impossible to organize the courses required in time. Thirdly, there must be some organization at a centre which will keep itself apprised of the places for special

study, of the possibilities in particular lines of research, and of the way in which men can be grouped at various educational centres to provide suitable courses of instruction.

The third question in the Agenda Memorandum No. 1 relates to interchange of workers. That memorandum makes suggestions of the way in which interchange may be carried out. It is very difficult to speak on this subject without using exaggerated language —the possibilities are so great, the opportunities so many. We have the greatest Empire in the world. We have a people not without fame in original conceptions or practical application of these conceptions, and it should be possible to find a method of team work in many of these subjects of Empire research. In the non-self-governing Colonies we have two million square miles with 55 million people living mainly on agriculture ; we have new areas continually brought into effective occupation by the discoveries of medicine, by the application of veterinary science, by new methods of transport, and by extension of the Pax Britannica. I would like to quote the definite opinion of Mr. Faulkner, of Nigeria, that the practice of shifting cultivation can be altered. Such discovery will result in enormous increase in forestry research, security of timber supply, more land being available for other purposes, and an enormous increase of the population on the soil. This discovery has application in India and West and East Africa, and many other parts of this great Empire of ours.

In conclusion may I say that while our safety may lie in the ocean, equally the safety of this Empire lies in its progress. We must create a service which is great. We have so much to do that we must see that, however few research workers we have, their work is put to the best advantage. I am sure that on this question of interchange of workers many suggestions will be put forward, but I feel certain that the greatest step forward towards interchange of workers will be the present Conference which brings the thinkers of the Empire together, not only at this meeting to-day, but at our Committee meetings, and our travels through the country, and at subsequent Conferences.

I believe that many of these matters will be solved slowly as is our habit. We agriculturists unfortunately do not control the purse strings. We know the number of workers is limited ; let us build slowly and be sure that the foundations are sound and that the bricks we lay will remain in place.

Dr. P. J. du Toit (South Africa) : All I can do at this stage is simply to underline some of the points mentioned by Lord Lovat in his address. The first point which could hardly be overstressed when we speak of recruitment of scientific officers is the question of the prospects that we hold out. As an example, workers in the Veterinary Service in South Africa may be contrasted with entomo-

logists in the Department of Agriculture. We have had no difficulty in getting men to join the veterinary service because the prospects that we offer to the veterinary workers in South Africa have always been tolerably good. At any rate there were always some plums at the top to which the men could aspire. On the other hand in entomology the prospects were none too rosy, and in the last two years it has been almost impossible to get a single man to take up entomology. In this connection too we should remember that the possibility of employment is a very restricted one in these special branches. When once a man makes up his mind that he is going to study veterinary science or entomology or any other allied subject, his chances of a career are narrowed down to a very few possible posts: this keeps many of the best men out of the field. On the other hand, if Governments are really serious about fostering agriculture, they should give everybody who decides to take the course a fairly definite prospect of employment. We must remember too the point which Lord Lovat touched upon, that entering some of these fields does not mean a short cut to popularity. I am thinking of the veterinary science man who is stationed out in the field amongst natives or even amongst European farmers, and has the unpleasant task of enforcing regulations, which are often feared more by the farmer than the disease which threatens his cattle. That man certainly is not going to be popular, and if he has not security of tenure in his office and a fair remuneration, we cannot expect him to devote his best energies to his work.

In regard to the training of officers, the training centres should adapt themselves to changed conditions. It is perfectly true that it is good for any man to have a pure science training before he enters on a special field, but even in that special field he wants a special course of training if he is to be a research man. I am afraid we are adhering too much to the old type of training where a man prepared himself irrespective of the type of work he was to be engaged on later. In South Africa—and I say it with all modesty—in the veterinary field we have shown that it is advisable, in training men for Government work, to depart somewhat from the stereotyped courses that have been given for the last century or more at some of the older Universities and Colleges. We try to train our men there in an atmosphere of research. The scheme was worked out by Sir Arnold Theiler; all professors and lecturers are actively engaged in research, and in their daily intercourse with the students they automatically speak about their researches, and the demonstrations that are given are drawn from research work in actual progress. The result is that the student gets quite an intimate knowledge of a large percentage of the work in progress, and many of these students, young and inexperienced though they may be, can be put on to research work right from the day of their graduation. That, I think, is a point which should be borne in mind at some of

the older centres to which we are looking for the training of our research men.

In regard to the interchange of workers, a Conference such as this where about 200 delegates from all parts of the Empire meet together is the best centre at which the interchange of workers and ideas could be effected. I have known of many instances where an actual interchange of workers was first discussed and decided on at a conference such as this. When we, amongst ourselves, discuss our problems we probably hear about somebody in another part of the world engaged on similar work, and we realize that by sending a man there or getting a man from there we may promote the work on which we are engaged.

Mr. G. G. Auchinleck (Gold Coast): I want to say a few words on the subject of the memorandum from the Gold Coast, on the interchange of workers. In the earlier part of Agenda Memorandum I. the subject is mentioned briefly, and it is stated that interchange of that kind would probably be carried out for fairly long periods of two or three years. I am not quite certain why the period was made so long as that, as it struck me at once that there are many occasions on which a shorter period of about a year would be, if anything, more satisfactory in a general way. The memorandum which has come forward from the Gold Coast dealing with possible exchange of workers between the Colonies seems to me to cover the ground fairly completely. In the Gold Coast, and, I believe, also in other Colonies of West Africa, we are faced with problems for the solution of which special knowledge is required from other Colonies and countries which have tackled such problems. Hitherto the attempt has been made to deal with such problems by bringing in expert knowledge from outside. Frequently an expert from another country cannot, however, apply his knowledge in the short time available in the colony which he visits, and it does seem to me that better results would be gained if officers from a colony faced with these problems were sent to Colonies which had special knowledge of these problems. We are faced continually in tropical colonies with problems which are not agricultural in the narrow sense of the word, and they are brand new—their solution has never been attempted before. We have to work in the dark, and the greater amount of light we can get from colonies that have had similar experience in other parts of the world the better. Great benefit can be obtained in many cases by interchange of workers. The scheme seems to have the advantage of being cheap. There is no reason for further expenditure in most cases of exchange. If, for instance, there were an exchange effected between Nigeria and elsewhere in West Africa, it could be done at the time of the leaves of the two officers, in which event the passage money only would have to be paid. On the question of study leave, in a colony in

which I have previously served, arrangements were made for courses of training for a year or more, but we in West Africa do feel the need for some system whereby specialists can renew the learning which, in the course of years, is in danger of being lost. I do want to press the point that although this question of exchange of officers is a novel one, at the same time, it probably is the solution of a good many of the problems which face us in the tropical colonies.

Sir Daniel Hall (Ministry of Agriculture) : There is one point in Lord Lovat's address to which I should like to call the further attention of the Conference, and even possibly propose a resolution at some period. Lord Lovat was speaking of the difficulty of attracting the right kind of man into the profession of agricultural research, and he indicated that it might be desirable to increase the supply in some kind of way by dealing with the schools and inducing them in their later stages to pick out boys. I am not quite sure whether that will prove to be exactly workable, but there is one point where the schools can help us very much and where they are failing at the present time. Our schools are definitely urbanized in this country ; even in their science they are paying attention almost entirely to chemistry and physics ; they are paying little or no attention to biology. Now, that is the source from which we have to draw many of the workers that we require. We need men with a biological outlook. We want boys going to the University to go with some knowledge of biology, whether botany or zoology. In those fields of supply of geneticists, veterinarians, animal husbandmen, mycologists or entomologists, we find the greatest deficiency, because the boy who is entering on his definite scientific career has not had initial stimulus towards the study of the living organism. There are one or two schools that are notable exceptions, and if we were to examine the list of men who have passed out into the active service of the Empire in those directions we should find that these particular schools bulk large in the supply. At present we are in a vicious circle. The schools are not teaching biology, the recruitment from the biological schools to the Universities is small, and whenever you try to suggest, as has often been necessary in agricultural matters, to some secondary schools that they should give a biological turn to their teaching, their answer is : " We cannot get the men. When we want a science master we can get a chemist or a man who has taken a degree in physics, but we cannot get a man who has taken a degree in botany or zoology." We must stimulate our public and secondary schools to give more attention to biology. I say this not merely in the interests of our particular profession, but in the interests of education itself. No man can properly be regarded as an all-round educated man who does not fundamentally understand how a plant grows and how an animal lives and has its being, and, therefore, we have every right to impress upon the schools the importance of this fundamental aspect of human knowledge.

I do hope we may recur to this matter and perhaps arrive at some sort of resolution which should be submitted to the Headmasters' Conference to impress upon them the importance of preliminary biological training in our schools.

Sir John Farmer (Imperial College of Science): It has fallen to my lot to try to repair this great lack which we have of biological students, and I have been interested in this matter for a very long time. One source of the trouble lies in the schools as has been already said. Chemistry and physics are easy subjects to organize in the schools; biology is not so easy, but it ought not to be neglected and time ought to be found for it, both, as Sir Daniel has said, on educational grounds and also on materialistic grounds, and it is because this Conference does give an opportunity for recalling the Headmasters—who are a somewhat conservative body perhaps—to the practical necessities imposed by modern conditions that I hope we may get some strong expression of opinion from this Conference on this very important subject.

The difficulties of finding trained biologists will have to be solved in various ways. The Department of Scientific and Industrial Research has done what it can to emphasize the need, and to attract and help forward good biological students, by giving studentships or scholarships so as to enable men to do research, but as an ex-member of the Advisory Council I can say from experience that that Department has found the very greatest difficulty in getting anything like an adequate number of biological students who are worth training on. It is no good spending money upon these people unless they are good students; we do not want men to take biology as a soft option; such are no good. We do want to get a reasonable share of these able young men, but at the moment—and this is the real point—they are apt to come up to the Universities from the schools thinking that the only occupations which lie before them are in the direction of chemistry, engineering or medicine.

The Universities themselves are not entirely clear of fault in this matter. They do not sufficiently bring to the notice of those young men the fact that there is a real need for biologists. I believe this Conference can do very useful and good work by pressing on both the Schools and the Universities the urgent importance of practical attention being given to the matter.

Dr. du Toit said that special training was wanted and that stereotyped methods were wrong. I quite agree with him that any stereotyped method is wrong, but I think, as a matter of fact, a good deal of the scientific training of young people, at any rate in this country, is quite distinctly and consciously conducted by people who know the value of research—not a particular bit of research, but the encouragement of the research instinct—in securing a right outlook. You may have a person who has the

whole of the Encyclopædia Britannica at his fingers' ends, but—if any such person exists—he might easily be of very little use when it comes to solving new problems. Those educational questions are matters which concern you, and through you the Empire, in promoting the real progress of agriculture.

I cannot help calling to mind a very wise remark which was made to me many years ago by the managing director of a large rubber plantation. I asked him his idea of the kind of training he would like to be given to men coming out to him. He replied: "Do not try and teach them anything about rubber. They will learn during the first month out there more than you could ever hope to teach them at home. All sorts of things behave very differently in the tropics from what they might be expected to do by a person with a limited knowledge at home." He went on to say that the man should be given a good all-round scientific training and as far as possible encouraged to develop ideas. "If you can do that you have done as much as can be expected of you, and the man himself will have to do the rest. Anyhow, what he has got before him is a continuous series of real research problems and we want the man who can think these problems out from all points of view, hence he must have the necessary background of scientific knowledge, scientific outlook and training." I think it would be difficult to put the case for the kind of education that is really wanted better than that.

In conclusion I do hope that this Conference will express as strongly as it feels itself able to do the need of men and the opportunities before those who are properly qualified. There are plenty of able boys and young men who should be available, but they are apt to drift into chemistry or physics through ignorance of other opportunities. We want to get some of them, for there is at present a real paucity of first-class candidates—and I feel it is up to us here to do what we can to remedy the deficiency.

Mr. E. S. Archibald (Canada): I would like to express my appreciation of the whole discussion. All three so closely interrelated problems are dependent upon each other for solution, and had I the time I should like to express my views on all three. In Canada the problem of recruiting proper agricultural research workers is fundamental. Lord Lovat, I believe, expresses the real reason for the deficiency—a lack of plums and a lack of prospects for the research worker.

The second problem, the training, is so closely related to the first and so dependent on it that there seems to be no separate solution. We can scarcely, until we solve the problem of recruitment, expect to define a curriculum which is sufficient to meet the needs of agriculture unless we have the best brains on which to work. We are getting as a rule those least interested in the sciences who are taking up agricultural sciences, and the brighter minds interested in science are going away to the sciences of an urban

nature. Hence the curriculum of our Universities, both in the graduate course and the post-graduate course for agriculture is of necessity of a lower standard than one finds in medicine, law, or some of the other professions. Until we can hold out to the young men who are coming into agricultural sciences a future, in terms of dollars and cents if you like, which is comparable with that of other sciences, we cannot expect to define a curriculum sufficiently comprehensive and rigid to do justice to agricultural sciences of the present and the future.

I am particularly interested in the question of interchange of workers, for our research work in Canada would benefit very materially thereby. The very fact of an interchange being established would in itself induce more really good men not only to adopt agricultural science as a profession, but also to continue their post-graduate studies at home or possibly elsewhere, with the hope of working for a period of years with some of the great research workers in Great Britain or elsewhere in the Empire. The very fact of an interchange being established would induce more men to continue their post-graduate studies or even possibly induce some of the public school boys to go into agricultural science rather than into the sciences of an urban nature. There is one other comment which I would like to make upon this matter of exchange of workers, viz., the benefit to pure science workers in Great Britain of working for a period of two or three years on science problems of a more applied nature in some of the Colonies or self-governing Dominions. In turn many of our scientific workers in Canada are working on applied science, the solution of urgent practical problems being the first objective in their work, and the benefit to those men to be able to work for a period of one, two or three years with some of the great pure science research workers in Great Britain or elsewhere, would be very great. I am keenly interested in this matter of interchange of workers, and I certainly hope that something may be developed from this Conference which will be beneficial to the Canadian research workers in agriculture.

Mr. A. Holm (Kenya) : It so happens that I was closely connected with the administration of public funds for providing scholarships for the training of officers of an agricultural department, and it may interest the Conference to hear something of the way in which that scheme functioned. In 1908 the late General Botha, when he was the first Prime Minister of the Transvaal and Minister of Agriculture, initiated a scholarship scheme very much along the lines that are indicated in the Lovat report. That scheme was continued by the Union Government, and the results have proved to be of great value not only to South Africa but to the Union Department of Agriculture. The reasons which prompted the Transvaal Government in the first instance, and later the Union Government, to provide money for this purpose were chiefly two-

fold :—(1) the recruitment of specialist officers for the Department of Agriculture, and (2) to provide opportunities for promising young South Africans to fill positions in the South Africa Service. In carrying out the scheme itself two principles were laid down: (1) As far as possible the needs of the Department for some years in advance were forecasted and scholarships were awarded in order to meet those needs ; (2) the scholars were sent to that university or institution in the world where the Government considered that the best facilities were provided for specialist training. I can recall that in my time in South Africa, when we had something like 40 agricultural scholars in training, there were men being trained with the aid of these scholarships at three or four universities in the United States of America, at a university in Canada, at Berlin, Zurich, Oxford, Cambridge, Edinburgh, Dublin, and also as far afield as Australia. The men were trained as specialists in agricultural chemistry, dairying, animal husbandry, entomology, mycology, veterinary science, or whatever it might be, and the best possible facilities were given to these men by training them at what was considered to be the best institute or university in the world for the purpose.

With regard to the points made in the discussion itself, I agree on the whole with the view expressed by Dr. du Toit as to the linking up of education and research. Some research workers might say that there are disadvantages in being associated with educational work, but I think that on balance the advantages lie in linking up research and education, at least as far as education of post graduate standard is concerned.

With regard to veterinary work, I hope that the Veterinary Committee will recommend that scholarships for post-graduate training in veterinary science will be awarded along very much the same lines as scholarships for training in agricultural science. The training of veterinary officers up to the attainment of Membership of the Royal College of Veterinary Surgeons is in itself inadequate for the purpose of State veterinary services and the equipment of officers who have to serve Colonial Governments.

With regard to the question of interchange of workers, this subject was very fully discussed at an Agricultural Conference which was held in Kenya in August of last year, a Conference attended by delegates from ten different countries, and after full discussion that Conference passed this resolution :—

> "That the temporary exchange of technical specialists between dependencies in East Africa is in the present circumstances inadvisable. It is emphasised that the temporary attachment of specialist officers of one department to another for special work is most valuable and further that greater facilities for visits of specialist officers to neighbouring dependencies should be accorded by Governments."

We realised that there are administrative and other difficulties connected with the exchange of officers serving on the ordinary establishment of the Agricultural Department, as between one territory and another, but we recognized also the value of the interchange under a scheme of temporary attachment of specialist officers. Now, in my judgment, this difficulty is likely to be overcome and some solution is likely to be found by effecting interchange of officers through the Imperial bureaux which we hope to see established and extended, and from the central research stations that are indicated in the report of the Lovat Committee.

Mr. G. A. Julius (Australia) : It is impossible to over-estimate the value of the address which Lord Lovat has given to this Conference. Upon our Agenda there is no subject of greater import than this matter of man power. At the present time we find ourselves bidding against one another for research workers. Here, most of us represent Governments through research organizations, or, at least, organizations in which Governments are largely interested, and when it comes to a matter of bidding we cannot compete with private organizations and individuals.

The consequence is, as we find in Australia, that every year, as graduates come up from the University, they are picked over by private employers and corporations, the best are taken and the Governments get what remain. This system is intolerably bad in view of the great research work and the great national services undertaken by Governments. As is well known, five out of six of our State Governments are Labour Governments that have been extraordinarily generous in the provision of hundreds of bursaries for free admission to the Universities of Australia, yet when it comes to the placing of the men so trained, the best men—partly due to the cause mentioned by Sir Daniel Hall, an earlier training in physics and chemistry, and partly due to the fact that more "plums" are available and prospects are better in medicine, engineering, law, and so on—go into these professions and the worst go into the biological sciences.

So bad is the position in Australia that it has become almost impossible for us to get really first-class men to take advantage of the scholarships now offered by the Commonwealth Government for work elsewhere. I am inclined to think also that it is not only this lack of plums and prospects in agricultural work, it is even more the failure to realize the fundamental importance of agriculture to national well-being. It is becoming a question of the most serious nature as to how we in the various Dominions—and in Great Britain also I presume—can adequately staff our research organizations in agricultural sciences. It may be of interest just to state what we are trying to do in Australia in this particular direction. The Commonwealth Government established a fund of £100,000 to be devoted purely to the training of research workers. We offered scholarships

annually to the value of £300 a year for two years, with £150 added for travelling, and all special fees paid. We took an option over the services of the men on their return guaranteeing them three years' employment, the first year at a minimum of £400, a minimum of £450 for the second year, and a minimum of £500 for the third. We offered such a scholarship, amongst others, for men interested in mycology; we did not get one application. We sought plant breeders; we got no response. Many were offering in physics and chemistry. The consequence was that, whilst last year we were able to send away ten men for intensive and research training, most of those men took subjects associated with physics and chemistry because we could not find suitable material to send away for training in the biological sciences.

This Conference could do work of enormous value, first by persuading Governments and organizations that the rewards offered for work on biological sciences must be increased so that better men may be attracted, and, secondly, by stimulating public opinion in regard to the overwhelming importance of the agricultural sciences to the national well-being.

Sir Gerald Strickland (Malta): The few remarks I venture to make are from the point of view of a pensioned Civil Servant. I wish to ask this Conference to keep in mind the great importance of considering and defining the pension position and increasing pension attractions. Lord Lovat's speech has indicated how to get the best men into the service under present conditions.

After we have got good men we must keep them. Not only must they be kept in the service in competition with outside employers, but they must be kept in competition with the claims of their families when they experience the discomforts of serving the Empire in all parts of the world and under bad climates. It has been the keynote of remarks repeated here that interchangeability is essential to obtain marked and rapid success in research. I wish to point out that this interchangeability is unachievable without interchangeability of pension rights. The pension attraction is very much more powerful than appears at first sight. The attractions of having a pension after thirty years' service in the Colonial Office have always been present in my mind. Now, the successful research officer is a combination of a genius and a plodder. You cannot get the plodder without the pension, and a good one. You may catch the genius with a good salary, but it is very difficult to keep him. You certainly will not catch a genius on the cheap, neither will you discover him by competitive examinations, that elusive expedient favoured by administrators who do not take the trouble and cherish the earnestness necessary to pick out the best men. In the Colonial service the ability to keep the senior officers, especially in that most sweated branch of the service, Governorships, was almost hopeless until pension rights were treated

Imperially and became independent of the particular colony where service had been performed. This is an important point in the discussion before us—pensions must be an Imperial organization, and, if possible, paid through the Colonial Office as a Central Bureau, of course after actuarial valuation of contributions to be obtained directly and indirectly from the various sources.

In conclusion, I would like to suggest that in connection with the attractions to be held out to get and keep the class of men that we really want for this most important work, the attractions of agricultural research should be put forward to candidates themselves in their youth, and to their parents when they make the choice of a career in life for their sons. When it becomes a question of submitting to the inconveniences of living upon a few trunks and packing cases and being transferred from one Colony to another, the pension objective saves a man from leaving the service and should be held out from the beginning and be very generous and include pensions to widows and orphans. I feel that without some such organization, without boldly facing temptations to leave the service from the beginning, it will be impossible to obtain any large number of officers of the type for example of Farrer, in Australia, who has added millions, and even tens of millions, to the potential wealth of Australia by his discoveries in the breeding of wheat. The possibility of obtaining other creators of similar additions to Imperial wealth ought to prompt Governments to contribute very generously to an Imperial pension fund.

Among other attractions likely to bring men into the service there has been mentioned at this Conference the prospect of promotion—a very attractive prospect—but unless there are substantial offers of pensions combined therewith, prospects of important promotion are delusive.

Sir James Currie (Empire Cotton Growing Corporation): Sir Gerald Strickland's last remarks impel me to say that I do not think that the pensions system, as we have seen it, fits into the needs of the research workers we are trying to recruit; I favour something a ong the lines of the University Scheme. In England a man can carry his rights on his back as he goes from one post to another. I think you would find that system very much more adapted to the actual needs of the situation. I often think that your pension scheme just now really amounts to the baiting of a rather poor booby trap. The effect of it is really to pin a man down. It makes mobility difficult when the one thing which you want is to encourage mobility. Some development of the University Superannuation Scheme would facilitate recruitment more than tinkering with the actual pension system itself.

I do not think that either Lord Lovat or his committee has quite envisaged the amount of increase that will have to be made in the attractiveness of the plums to which he referred, when the

increase in the cost of living all over the world is considered. I know enormous improvements have been made in the last few years.

I hope that the self-governing Dominions will pardon me when I say that as far as my experience goes, the material attractions offered appear in many cases to be very substantially less than elsewhere. I do not know the reason, and I cannot understand it. The representative from Australia touched on that in his last remarks, but I think the conditions there, if they are investigated, will be found, especially as regards biological work, to be considerably worse than they are at home.

Sir Henry Lawrence (India): The suggestions which Lord Lovat made for a pool of scientific workers at Universities will tend towards a very important alteration—in fact a revolution—in the educational system of schools. Such suggestions will meet with considerable opposition. Those suggestions have received the valuable approval and support of eminent scientific workers, but it must be recognized that the opposition from schools, based on the old mediæval system of classics, will, most unjustly no doubt, seek to discount the approval of scientific workers as being merely the enthusiasm of scientific men for the growth of their own subject. I should like, therefore, to attempt to re-inforce Lord Lovat's suggestions from the point of view of a layman who has been merely an administrator.

One of the bodies whose assistance will have to be secured, if we are to make this pool of scientific workers in the Universities a success, will be the Civil Service Commissioners. I understand it is exceedingly difficult for a man who has been trained in the natural sciences to obtain a successful place in the examinations held by the Civil Service Commissioners. Those examinations, I take it, are to test fundamental qualities of character and intellect and industry, and I do not suppose this Conference will regard it as impossible that men trained in science should be possessed of those qualities, but I think it will be necessary to persuade the Heads of the Colleges in the great Universities, the Heads of the great Public Schools, and the Civil Service Commissioners, that natural sciences are capable of being used in the formation of those fundamental qualities.

In India certain Governments have made a point of recruiting to their provincial services (recruited from Indians) some men trained in scientific colleges, and particularly in colleges of agriculture, in their provinces, and the men so recruited for the Civil Service in India have proved valuable and efficient servants of the State

It has been the history of education in England that private benevolence has provided fairly ample endowments, but limited almost entirely to the classics, mathematical sciences and the arts.

It will take a very long time before the public at home learn that it is to the benefit of the country to endow the natural sciences with scholarships in the same manner as the old arts have been endowed, and, therefore, since the Government have quite recently, as we were told yesterday by the Minister, recognized their own responsibility for the promotion of agricultural science and within the last few years only have spent money for the promotion of agricultural science, I suggest to this Conference that they should recommend that the time has come for the Government to follow the example of Australia, as we were told by Mr. Julius just now, in providing an ample sum for the endowment of scholarships in natural science at all our great teaching institutions.

In particular, I would like to plead the cause of veterinary science, because I think no science has been left so completely in the shadow of neglect as veterinary science in England. We know that very large sums are spent on certain subjects—I refer particularly to the losses of cattle through Foot and Mouth Disease—but at the same time the sum provided for research in that particular subject is astonishingly small.

One gentleman referred to the importance of recognizing the services of scientific workers by sufficient salaries. This Conference might like to consider what has been done, and the excellent example that has been set in that respect, by one of our latest and newest colonies, the Federated Malay States. I understand they remunerate their scientific workers at a considerably higher rate than they do their administrative staff. That is an astonishing phenomenon, the details of which might well, I think, be placed before this Conference.

Major Walter Elliot, M.P. (Empire Marketing) Board: The need that we all recognize for the provision of a greater scientific personnel may lead us to a bad result, in this way, that to start off with a large number of scholarship schemes just now and get a number of recruits into the Service in a hurry will in a very few years produce an appalling block in promotion, and nothing worse could well be imagined for the men that we want just now. We want to pick them rather from the senior men than from the junior men. They can be got from the senior men if we are prepared to pay for them. This is a question of finance.

With all humility I rather disagree with the suggestion of the eminent Prime Minister of Malta that the fat pension is the proper lode-stone for the scientific worker, and I do rather agree with Sir James Currie, who said there is a suggestion there of a well-baited booby trap. You have the risk of a man who has become much less easily interchangeable if he has been brought into the service with a heavy pension scheme. I do not think it is a bad thing that people should be picked over between industry and Government Service. As free a movement as we can secure out of

the scientific research service towards the world of industry, and the world of practical agriculture, and back again, is much more the ideal at which we should aim, than an escalator on which every year a man knows he is proceeding by steady steps towards retirement. In that case, what a man looks forward to is his retirement ; what we want him to look forward to is his work, and our policy, as far as we can manage it in Scotland, for the government of which I am partially responsible, is that we would rather, if we had £50,000 to spend, spend it on ten men at £5,000 a year each than on an unlimited number of small pensions to people to retain them in the service. If we are willing to pay for the men we can get them.

It is not quite accurate, as Sir Henry Lawrence suggested, to say that there are no great endowments for the biological sciences. The great science of medicine is a great biological science, but it requires no endowments or scholarships. The middle-class people are perfectly willing to support their sons during five, six or seven years' training in medicine, because they know they are going to support themselves after training. If you give a man a job in which he can save money for himself, in which he has got prospects, with an insurance, as has been said by one speaker, that he can carry on his back from place to place without a heavy pension, you will find people supporting their sons and putting them in that line of work. The long-sighted man will prefer to go to where he can support himself and have a job of his own rather than a place at which he has to remain year after year, hoping and praying for the time of his retirement when he can go and grow pansies in Kent. I would suggest that we should keep in mind for our immediate purposes the necessity of recruiting from the top ; of recruiting the senior men who will sooner, rather than later, pass out of the service and leave no block in promotion, but leave chances for the young people who meanwhile are training. For that purpose we should have a few good plums to bring in good men if they are outside and provide opportunities for good work.

Last, but not least, attention should be paid to the social prestige which attaches to people when they are in a service which is recognized by the Government as a really first-class service. I am sure we all feel that veterinary science has suffered from the mere fact of its name. It is a difficult matter to get people to come into the veterinary service because, for some reason or other, it has been regarded not as one of the great branches of practical biology of which the doctor and the veterinarian are the two halves of a whole, but as something separate and inferior. We want to reverse that impression. During the munitions crisis of the war, there were two policies, the policy of pumping men in and the policy of creating a draught. If you create a draught, you will find that good people will flow in. When we have good posts to fill we shall have good men to fill them.

Major G. N. Blackshaw (Southern Rhodesia) : I would like to endorse the remarks which have been made by Sir Daniel Hall with regard to the importance for the agricultural research worker of the study in the schools of biological science, but I would warn those concerned with the arrangement of the curriculum in schools not to allow, in meeting such an end, the pendulum to swing too far, because we have to realize that, for instance, chemistry is a science of fundamental importance in every branch of the farming industry. Therefore, we must not, in developing the study of biological sciences in our secondary and technical schools, overlook the fact that chemistry is of equal if not of even greater importance.

It has been my experience in the years in which I have been engaged in agricultural science that we are likely to get the most suitable recruits for agricultural research from those who have taken an honours degree in pure science, and who have subsequently specialized in the branch of agricultural science which they desire to take up ; but one must not lose sight of the fact that provision must be made for the training of agricultural field officers who will naturally take, in most cases, an agricultural science degree. That does not preclude such workers from the possibility of gaining a position in the sphere of agricultural research. As we know, some eminent authorities have said that a research worker is born, not appointed, and if the field officers exhibit original genius or marked ability for agricultural research, then those men could be gradually taken into the fold as opportunity occurs.

The Southern Rhodesian Government, I know, place great importance upon the value of an interchange of scientific workers, and by that they mean that if scientific workers in any part of the Empire wish to pursue in other parts of the Empire the line upon which they are engaged, facilities for that purpose should be provided for them.

Mr. A. S. Haynes (Malaya) : Sir Henry Lawrence made reference to the remuneration of the scientific workers in Malaya and I understood him to suggest that they were more highly paid than the administrative staff. I take it that he was referring perhaps to the Rubber Research Institute of Malaya, which is a newly constituted institute which I have the honour to represent here. The Institute is not a Government Institute. It was first suggested by Dr. Butler on a visit to the Malay States some years ago, and after very lengthy negotiations and much consideration, the Government, at the request of the Planting Industry, established the Institute and collects a cess on the export of rubber, from which the staff of the Institute are supported. The Government has, I think wisely, handed over the control of the Institute to a Board, on which there is an unofficial majority. The Board is incorporated by law, and except for the fact that there are a few Government officials appointed by the Government on the Board, it is independent of Government control. That is found in practice to be a

very great advantage. I act in the dual capacity of President of the Board and as Secretary for Agriculture, and am able to compare the two offices. Meetings of the Board of the Rubber Research Institute are conducted on the same lines as the meetings of the Board of any commercial company. The Board engages the staff which it considers necessary, and during some nine months it has engaged a quite eminent staff of some 16 scientific workers. It has bought land and built houses. During that time—in fact, during a greater time than that—the Government has failed to do any one of these three things. For more than a year the Agricultural Department of Malaya has been endeavouring to obtain five officers. So far it has obtained none of the five, but during a shorter period the Rubber Research Institute has obtained sixteen. It appears to me that this is an extremely striking instance which should be on record in the proceedings of the Conference to show that where adequate inducements are offered, the staff will be forthcoming. The Rubber Research Institute has adopted a generous scale of salaries and so far no pension scheme has been decided upon, but it is extremely probable that a provident fund scheme will be brought into operation instead of a pension fund. I support very strongly the remarks of Sir James Currie in his preference, as I understand it, for some kind of provident fund instead of a pension scheme. The pension binds the officer to his post for perhaps an unduly long time. An officer might enter the service of a Government at the age of 25, and, in the Malay States at any rate, he cannot retire until the age of 50, except on a medical certificate, when he may retire with the consent of the Government on a reduced pension. Retirement at 50 is optional, on a reduced pension; retirement is compulsory at 55, but I think it will be found that there are workers who find that 25 or 30 years' service is a longer time than they can adequately support tropical conditions. Many a man does extremely good work for 15 to 20 years, but after that time he is no longer capable of the same concentration, the same diligence, the same enthusiasm in his work. Under the pension scheme it is impossible to get rid of that man. The Government has no power to get rid of him, and he himself of course will not resign because he feels that he will lose his pension. The contractual obligation on each side is one which cannot be dissolved. Under the provident fund scheme, such as is adopted by many commercial firms in all parts of the world and by such bodies as the Municipalities in Malaya, the worker and his employer are, it appears to me, on better terms. The worker has from the beginning of his service a small capital sum which is gradually increasing, and if at any time it is to the advantage of the employer or the worker that the relationship should be severed, this is possible without undue hardship to the officer.

On the subject of recruitment, I have given specific instances in which the Rubber Research Institute has been enabled to obtain

staff while the official Department of Agriculture has been unable to do so. Not only has the Department of Agriculture been unable to obtain staff, but it has been unable to retain staff in comparatively recent years. Many officers recruited for that Department were, during the period of great prosperity in rubber, persuaded by superior inducements to enter planting concerns. Their pensions did not weigh at all in the matter, they were able to secure such good terms, the value of their services was so fully recognized by the planting companies and was, if I might say so, so inadequately recognized by the Government, that they left their Government employ and undertook commercial work very much to their advantage.

On the subject of study leave, the Japanese and American Governments have a scheme of allowing their officers to go for study leave, which I think would be worth investigation by the Conference in order that some such system may be adopted. It is useful to have an example on which to go instead of striking out blindly into something which has not been tested in other parts of the world.

Sir John Russell (Rothamsted Experimental Station) : While agreeing with Sir Daniel Hall and Sir John Farmer that a great deal could be done in schools, we have to recognize that the inducements are not at present attractive enough to draw the best men into the service, and that is because in recent years a new factor has come into the situation, namely, the recognition by big commercial firms of the value of public school and university training ; and the one thing that will have to be settled is whether the whole Empire technical services are or are not as important as commercial work. I am not going to speak on that, because it is more a question for a Commission than for the full Conference.

I will say nothing further as to salaries, which subject has, perhaps, been sufficiently ventilated. Something can be done to add to the attractiveness of the existing posts, by making a better linkage between the various Home and Overseas services. In the first place one still hears young men, to whom the idea is suggested of going out, putting forward the old idea, that once abroad a man is always abroad, and that seems to act as a deterrent. Secondly, there is the very real problem of what is to become of the man who goes to an overseas post and whose health does not stand the climate or the conditions ? If he knew that he could be brought into touch with other posts elsewhere or at home it would relieve his apprehensions. We have been able at Rothamsted to obtain one or two able men who went out and found that for some sufficient reason they could not remain overseas. Nevertheless, at home they make splendid workers. It was only by accident that we heard of at least one of them, and had there been some means by which we could automatically have known of that man he would have been saved several months' serious anxiety. There is, thirdly, the case of men about to retire. We have considerable correspondence with over-

seas men who are about to retire in a year or two, and wish to know of posts that they could take here. A clearing house to handle such enquiries would help considerably.

Lord Lovat spoke of what could be done for men on leave. That is a very real problem, and I suggest that it may be advisable to draw up a short statement setting forth the institutions that can help men who are at home either on short leave or study leave, and emphasizing the fact that these institutions would be very glad to assist them. The Colonial Office help us by sending to Rothamsted each month a list of men home on leave ; to each of these we send a personal letter saying that if he will come to us we shall be very glad to see him. I am sure that my colleagues at other experimental stations would be willing to act in the same way.

I would have liked to have heard more this morning about the interchange of workers. We have tried the experiment at Rothamsted of sending out one of our younger men to the Sudan for the season for the specific purpose of ascertaining if certain methods that had been worked out at Rothamsted would be helpful to the technical staff there. The experiment was completely successful so far as we are concerned, and we hope it was satisfactory also to the Sudan. It showed that the exchange of workers between home and overseas stations would be very useful. At home we are developing fundamental methods some of which may be of considerable value to workers in the field in particular circumstances, and it is a great advantage to send out a man for a few months to try them and see how they work.

4.—Chain of Research Stations.

Wednesday, October 5th, 1927.

Major Walter Elliot, M.P. (Under-Secretary of State for Scotland, Chairman of the Research Grants Committee of the Empire Marketing Board) : We have, this afternoon, to consider the subject of the proposed chain of research stations throughout tropical and sub-tropical parts of the Empire. Now we have before us, in Memorandum 2* of the Agenda, the documents, so far as the Organizing Committee have been able to collect them, on this subject. You will find the various official resolutions which have been passed on the subject by Imperial bodies at one time and another, and you will find in particular that the Imperial Conference passed a resolution expressing its cordial approval of the project of a chain of research stations situated in tropical and sub-tropical parts of the Empire, and commending this project to the consideration of Governments, Institutions, and private benefactors throughout the Empire. The question was also brought to the notice of the Colonial Office Conference (the Colonial Governors' Conference), and they accepted the necessity for a chain of research stations throughout the Empire

* See Appendix B, p. 223.

and suggested certain regions where these might appropriately be located. To-day the project comes before a technical audience, which, of all audiences that can be found, is the most suitable to consider and pronounce upon it ; and before those who will have to work the scheme, who will have their agricultural duties made either more difficult or more easy by the decisions which we take in this Conference. The matter is of very high importance both for the future of agriculture—certainly of tropical agriculture in general—for agricultural institutes, and also for the Governments that are here represented.

Now we must begin with definitions. Firstly, note that we are concerned with tropical and sub-tropical agriculture. The chain of research stations has, therefore, to be considered more particularly in relation to the Colonial Empire proper, although the relations of other great regions of the British Empire to the project will, of course, be very important, notably the Indian Empire, tropical and sub-tropical, the Dominion of Australia, which has a considerable portion of its territory within the tropical and sub-tropical line, and its Mandated Territory lying wholly within that area ; and the Union of South Africa, which is closely and intimately concerned with the future development of tropical and sub-tropical agriculture.

In the tropical and sub-tropical belt of the British Empire one may say the governing features are heat, salt water, indigenous races and a numerically small immigrant race. These factors impose certain considerations upon our discussions. We are to a considerable extent dealing with scientific workers who come in from outside and who pass away from those regions again. There are certain areas in which that does not apply at all—to the Dominion of Australia nor to any great extent in the Union of South Africa—but it applies very materially in certain of the great tropical and sub-tropical countries where at present the research services are very largely manned by people trained in the universities and schools of the temperate zone, who come into the tropical zone for work and pass out on retirement. We must remember that as the governing factor of the whole problem before us. It is not a problem which we can discuss mainly on the lines of the Dominions, the self-governing states of the Empire.

Secondly, the word chain. We have to be very careful of words in these matters, and let me make it clear that by a chain I do not mean anything in the nature of a fetter. I understand that the whole conception of the mandate was completely wrecked in the middle east because when you render the word mandate into the middle east language it means the relations of a master to a slave. It is only too easy to get wrong about words, and, therefore, it is the linkage of the chain that you must concentrate your minds upon when the word chain is used in this connection. That is very important because naturally in the service where these links are to

be established, places wish to be linked up, to have association with other workers and other stations in other parts of the world, but they would resent it bitterly if there were restrictions laid upon them by some outside body over which they themselves could have no influence. By a chain I mean, therefore, a linking.

Thirdly, a research station is a very difficult term to define. Before you in Agenda Memorandum 2 there is a very interesting memorandum by Mr. Faulkner of Nigeria to stress the point that by a research institute he rather means something of the nature of an agricultural college on the ground that you have the trained man, and the essence of an institute is its success in training the people who are subsequently going to do the work. That will no doubt come up for discussion as the afternoon goes on. But it is not exactly what I had in mind by a research station. I had rather envisaged the stations as being formed from or developed out of existing institutes or developed in close relation with existing institutes ; as being regarded by themselves and the outside world as of equal status to anything in the Empire ; and as having their facilities for work and study brought up to the highest level, if necessary from central funds. That is a point of considerable importance. They should be spaced out across the world with a wide view, but in accordance with the opportunities of work which would be open to them

Finally, in my view such stations should be of such high technical competence as to make it inevitable that technical work cognate to their own, but not actually theirs, must be undertaken by an allied station and not by the institution of a fresh department of their own.

Stations of this importance would require to fulfil certain postulates. Firstly, they must be few in number. You cannot have any large number of such stations. I should say five or possibly six, and at the very outside seven, and even that number we should not achieve for several years—possibly many years. Secondly, they must be adequately staffed. We were discussing some of these problems this morning, but you will see, on the terms which we are discussing, an adequate staff for a station such as this is absolutely a *sine qua non.* It is not enough to have one or two or even three or four people working together. You must look forward to a staff of whole-time competent workers, I should say certainly not less than 8-12 if possible, or perhaps an even larger number. That is obviously an ambitious project, but it would be better to have one or two such stations of that order with staff as numerous as that, than to spread your butter thin and possibly find—to change the metaphor—that instead of piling the coals on to the fire and getting it to burn up you spread it out and let each individual lump expire in a lonely little desert of its own.

That brings me to the other important question of finance. On the finance of research stations I should say that Sir John

Russell considers that a reasonable budget for a research station is, I think, £90,000 a year. That is a considerable sum. I do not think that there is any station in Scotland or England with a budget approaching that figure, but Sir John Russell will be able to enlighten us further on that point. Take somewhat more modest figures—the College of Trinidad, that has a budget of £25,000 per annum. Take Amani, to which the neighbouring Government have guaranteed, I understand, £8,000 a year, and the Empire Marketing Board up to another £6,000 a year, making a total budget of £14,000. The Queensland Station which has been the subject of preliminary correspondence between the Australian Government and the Empire Marketing Board has been provisionally considered at something of the order of £10,000 a year, and there seems to be little doubt but that these estimates will be considerably expanded if and when such Stations are in actual being. These are amongst the figures which will be useful as a basic line. We should all like the opinions of those sections of the Empire who have had experience in the foundation and running of research institutes under tropical and sub-tropical conditions.

I come to the question of, so to speak, allied agricultural areas, and in that I would naturally put India first and foremost. The position of India is different in that it has at present a Royal Commission examining its agricultural problems, which has, I believe, even taken into account this project of the chain of research stations, but since the matter is under discussion it would not, of course, be possible for me to do more than take note of the expression of opinion that the Indian delegates can give on the staffing and running of their own Institutes, &c. The Colonial Conference in May set up a Committee which is hard at work hammering out the actual details of the scheme for the Colonial Empire, and it has already approached the Empire Marketing Board on the question of the financial assistance which may reasonably be allowed from central funds towards the local funds which such a scheme as this contemplates raising. Now, in the case of India, of course, matters are entirely different, but from the scientific point of view the matter cannot be without interest to the research services of India, and to the development of Indian agriculture, and when giving evidence before the Indian Royal Commission, I found that the members of that Commission were keenly interested in the project. Whether they think it right to take any action is a matter entirely within their own province.

We have then a project of research stations of a high order staffed with a considerable staff of people of the highest possible competence who should receive the most generous treatment that it is possible to give. That is to say they should receive opportunities for study leave, for interchange, and in other directions, arranged not in accordance with what we can afford to give them, but with what they can possibly take advantage of.

These stations would fall into certain groups, for which the Colonial Conference suggested the West Indies, West Africa, East Africa, the Far East, and possibly the Middle East. You will see this on page 1 of Memorandum 2.

In summing up the duties of these Stations, I think that they should concentrate on work which would accord with the opportunities which would be afforded to them by the type of agriculture which they would find at their doors. The particular examples that I would give would be as follows :—

West Africa.—There is an export of oil, palm kernel, valued at $10\frac{1}{2}$ million pounds a year, and of cocoa valued at $9\frac{3}{4}$ million pounds a year, i.e., a total export valued at over 20 million pounds a year from that region of vegetable oils and fats. It would, therefore, seem reasonable to suppose that such a station, if developed in West Africa, would concentrate upon the problems of agriculture connected with the growth of vegetable oils and fats.

East Africa.—Although the production there is smaller, yet it is important, and when I say East Africa I mean the eastern region of Africa. Exports of cotton are valued at $5\frac{1}{4}$ million pounds, and of sisal at $1\frac{1}{4}$ million pounds ; a total export valued at $6\frac{1}{2}$ million pounds of fibre. Therefore, I think it might be reasonable to suppose that such a station would turn its attention to a considerable degree to the problems involved in connection with fibre products. As this region also exports £1,250,000 of coffee, there would also seem an opportunity for work on coffee.

Australia have already determined to establish a station for tropical Australia in Queensland, and have recently cabled final acceptance of the terms provisionally drawn up between Mr. Amery and Mr. Bruce at the Imperial Conference. The exports of wool and meat from Queensland are valued at no less than 16 million pounds a year, and of dairy produce at 3 million pounds. It would, therefore, seem reasonable that any station established in Queensland should find a considerable amount of work on problems of animal husbandry in the tropics, particularly in connection with wool and beef, and, to some extent, with dairy products.

The last thing I wish to say is this. I have said that to produce these stations will take a considerable time. The question has been discussed repeatedly in reference to stations in existence and to the order of priority in which we should attempt to bring new stations into existence. The views of this Conference will be of importance on that point, and we shall hope to elicit them this afternoon or later. We have already the College at Trinidad in existence. We have with us here the Director of the Amani Institute in the eastern African region, which has now begun to be reconditioned after being allowed to fall to a state not very creditable to British agricultural science. We have a suggestion for the establishment of a further station for which the claims of that at Peradeniya in Ceylon have been strongly pressed, and, I think,

with great justice. We heard this morning of the Rubber Institute which had been set up in the Federated Malay States. Tea and rubber, are also, of course, of great interest to Ceylon, and, therefore, it would seem that somewhere in the British Empire we should do our utmost to foster fundamental research of the problems connected with the production of tea and rubber. I look forward with some interest and not a little trepidation to the debates between the Federated Malay States and Ceylon as to which, if either, should have priority in a matter such as this, but I hope we may be able to arrive at an amicable solution. The production of rubber and tea in the British Empire is of quite sufficient importance to warrant attention being given to them in both Malaya and Ceylon, even if the station in one of them has to be established sooner than in the other.

As to the station for West Africa, and I use the term West Africa to embrace the general region, their services are already being developed very rapidly, and it seems reasonable to suppose that before long a claim will come from them that their work is of sufficient Imperial importance to warrant Imperial recognition, and also a possible grant from a central fund such as the Empire Marketing Fund.

As regards South Africa: anyone speaking from one of the Dominions, even such a proud and ancient dominion as the Dominion of Scotland, walks delicately when discussing any of the internal affairs of the self-governing Dominions, but I should say that the work and position of the station at Onderstepoort, render necessary its consideration in connection with this scheme for a chain of stations, and the relation of its work to the proposed chain of research stations would be a matter for discussion here between the Government of the Union of South Africa and the other Governments concerned in the proposal.

Lastly, on irrigation. None of the projects which have been considered so far, except for a very tentative suggestion from Australia, have brought forward a real proposal for the establishment of a first-class station working out the fundamental problems involved in the application of water to parched lands. In this, it seems to me, we are subject to reproach in the British Empire. We have capital expenditures on the Murray River project, 5 million pounds; on the Sudan dam, $11\frac{1}{2}$ million pounds; and in the Indian Empire, 67 million pounds; a total of $83\frac{1}{2}$ million pounds in the British Empire, and I am unable to find that fundamental work on irrigation is being pursued anywhere within the British Empire with the intensity which the amount of desert land within that Empire would warrant. I find enormous areas of desert land in the British Empire. I find great projects being undertaken for applying water to these areas, and I have an uneasy feeling that there are many problems connected with the application of that water to that soil which we shall begin to find out when we first

open the canals and turn the water on ; but we shall then be too late and great capital sums will have been expended, perhaps in a wrong direction or, at any rate, in a way which could have been made more fruitful by a certain amount of fundamental investigation on the problems involved.

These are the problems we have to consider this afternoon : the tropical and semi-tropical belt and the organization particularly of the Colonial Empire with regard to them ; the allying of this organization to the great self-governing Dominions with tropical and sub-tropical interests such as the Union of South Africa and the Dominion of Australia ; the siting and work of such stations, which, of course, cannot be laid down definitely, but can be indicated by a Conference such as this ; the possible demand for a station which has not yet been demanded which will carry on fundamental work on irrigation for the British Empire. I think that a project such as this, the running out of a series of stations, the base camp for the army of civilization to advance from into the new world which we see before us, but which we have not penetrated, let alone exploited, is an Imperial idea, and is the sort of thing for which we have the British Empire.

Professor C. Y. Shephard (Imperial College of Tropical Agriculture) : The work of the Imperial College of Tropical Agriculture can be grouped under three heads : (1) teaching, (2) research work, and (3) advisory work.

With regard to teaching we are training post-graduate students for the Agricultural Departments of the British tropics, and for the Empire Cotton Growing Corporation. Provision is also made for private students and for refresher courses for senior members of agricultural departments. In addition there is a Diploma Course for under-graduate students from the West Indies and elsewhere. In this aspect of its work I imagine the College will differ from the proposed additional Central Research Stations

Research work is carried on by members of the staff and by senior students.

The College, on its formation, absorbed the work of the Imperial Department of Agriculture for the West Indies, which was much better appreciated after it had ceased to function—i.e., when the College took over its work—than when it had enjoyed a separate existence. I may add that a Travelling Commissioner has recently been appointed to survey the areas concerned, and to make recommendations for the continuation of the activities of the Department.

I have been asked to mention some of the difficulties with which we are faced. I will deal with them under three heads : (1) staff, (2) equipment, and (3) finance.

Until quite recently most of the Departments of the College were staffed by a single officer. His duties included teaching diploma, post-graduate and special students, research and supervision of research, advisory work of the Imperial Department,

and general college administration. Difficulties inevitably arose. An officer already fully engaged in teaching and research could not attend to an urgent problem in one of the islands without sacrificing the work of the College as a teaching institution. I agree with Major Elliot that an adequate staff is essential and would urge that the actual numbers can only be determined by consideration of the functions the institution is called upon to perform.

On the subjects of staff and equipment I may perhaps be pardoned for giving in illustration my own personal experience. On appointment to the Department of Economics at the Imperial College I became responsible for work, the nature of which I have already indicated, and, in addition, for the publication of the College Journal and the organization and control of the Library. My budget for the economic section amounted to something like £50 per annum for capital and recurrent expenditure, with £10 for travelling. A single visit to an estate at the other end of the island would absorb six months' travelling allowance. While it is essential to have an adequate staff it is equally essential to provide those officers with adequate equipment.

That the College is fulfilling a useful purpose is indicated by the fact that the demands on the College are growing more rapidly than its resources. Apart from research work initiated by members of the staff the College is endeavouring to breed a marketable banana more resistant to Panama Disease than the Gros Michel, is co-operating with the local Department in investigating the frog-hopper blight on sugar-cane, and is studying withertip of limes. With increasing demands must come increasing financial resources to provide additional staff, technical equipment, land, &c.

I would advance the further suggestion that there should be some definition of what has been termed " fundamental research " as contrasted with problems of purely local and immediate importance. There is the danger that local legislatures will tend to regard research stations as substitutes for, rather than complementary bodies to, the local Departments.

At this Conference we have heard a great deal about salaries. May I, in conclusion, again emphasize the importance of providing research workers with the facilities necessary for their work—a question of perhaps greater urgency than salaries. In this way alone can the College and other research stations fulfil the functions for which they are designed.

Professor A. E. V. Richardson (Australia): The project envisaged by the Empire Marketing Board and the Imperial Conference of placing a chain of research stations throughout the Empire in the tropical and sub-tropical regions meets with the very hearty approval of the Australian Government. During the past fortnight we have received advices from the Prime Minister that the Commonwealth Government is very willing to undertake the responsibility of establishing one of the links in the chain of research

stations that will ultimately engirdle the Empire. It has also agreed to undertake the obligation of financing the station and providing, with the Empire Marketing Board, a sum of £50,000 for capital expenditure and £10,000 per annum for maintenance. In view of what Major Elliot has said with regard to the necessity for adequate finance we, from Australia, are inclined to agree that the contribution towards this Station in tropical Australia will have to be much larger than that at present contemplated if its work is to be done effectively.

Now, the widely varying nature of the areas which might expect beneficial results from a station in Northern Australia necessitates the elaboration of a scheme somewhat different from that obtaining in a climatically homogeneous area such as Trinidad or even the more or less uniform area served by the tropical Institute at Amani. Tropical Australia covers roughly one million square miles, and if you add the comparatively large areas of mandated territory in the tropical regions outside Australia it is quite clear that that Station has to serve an area of territory approximately half that of the entire Crown Colonies, so that we realize the great responsibility involved in developing a tropical station in Northern Australia.

Now, the main features of this region are very varied indeed so far as climate, topography, and economic conditions are concerned. The country is relatively flat, it has a rainfall varying from 10 inches in the interior to about 160 to 180 inches on some portions of the East Coast. The whole country is more or less covered with a wealth of grasses, very varied in extent, highly drought resistant in character, and of fairly high nutritive value. Over the whole of this territory the stock industry has been well established, and, indeed, it is the main industry which has led to the development of those Northern parts of Australia. It would, therefore, seem that in the main the emphasis of such a station should be in the direction of animal husbandry, i.e., problems of animal nutrition and animal pathology. On the plant side the study and development of grassland under tropical conditions, i.e., tropical agrostology and tropical ecology, would seem to be particularly appropriate subjects for research, for in the last analysis the entire basis of the animal industries rests on the productivity and permanence of the grasslands. The economics of production, distribution and marketing constitute, too, an important part of the responsibilities of a tropical research station. The future settlement of Tropical Australia, which is so widely recognized as a matter of extreme national and Imperial importance seems to depend on the prior acquisition of the fullest scientific and economic data relating to stock, crop, and grass production.

I should like to draw your attention to another point of great interest in connection with the establishment of a station in Northern Australia. We are, in the tropical portion of Australia, attempting —whether rightly or wrongly it is perhaps for others to say—to

develop the whole of this country with white people, and in Northern Queensland we have probably the largest community of white people permanently settled in the tropics that is to be found in any part of the British Empire. It so happens that there is in Townsville on the east coast of Queensland a station for tropical hygiene and it does seem that the question of animal pathology could be very closely related to human hygiene. Those are the main problems which, at the moment, seem to require investigation in tropical Australia.

There is one other point to consider. In most other tropical countries practically all the physical work is done by natives. Now, in Australia we have our indigenous natives, but they are few in number, and of no value for developmental purposes. We have to develop our industries, agricultural and livestock, with white labour, and, therefore, it does seem as if the question of economics would also be of very great importance in connection with any tropical research station in Australia.

Major Elliot, in his admirable address, summarized the main factors on which the success of stations of this kind seem to depend. The Empire stations should be few in number, adequately staffed, staffed with whole-time competent workers, adequately financed, and they should confine themselves to problems which can be effectively dealt with instead of ranging over the whole field of work. Now, I think everyone will entirely agree with these views. So far as the question of finance is concerned reference has been made to that magnificent station at Onderstepoort. In order to give some idea of the financial provision deemed necessary for the development of research stations in other countries I might perhaps be allowed to say that the average expenditure of the 48 agricultural experimental stations in the United States amounts to £54,000, of which £36,000 comes from the States and £18,000 from the Federal Government. Now, on top of that, under the Act passed last year, an additional £12,000 is to be given to each station for the development of agricultural economics. These figures you see will correspond approximately to the order of expenditure at Onderstepoort, and personally I think that the expenditure that has been provisionally allocated for the development of the station in Northern Australia may prove inadequate for the satisfactory working of the station. However, Australia has accepted the obligation to create and develop that station and do what is necessary to make the work completely effective.

The Commonwealth Government is making substantial contributions to scientific and agricultural research. Hitherto the Commonwealth has not taken any active part in agricultural research, but during the last 12 months a total sum of £500,000 has been allocated from surplus revenue to the Council of Scientific and Industrial Research, £250,000 last year and £250,000 from this year's Vote. In addition to that a sum of £100,000 has been allocated

and handed over as a trust fund for the training of research workers.

In conclusion I would just like to make a passing reference to the very important matter that was raised by Major Elliot, the question of an irrigation research station. We in Australia are even more keenly interested in the development of an effective system of irrigation than we are in the development of a tropical research station. Australia is probably the driest continent in the world—I mean physically. One-third of its three million square miles has a rainfall of under 10″, another one-third from 10 to 20″, and one-third again a rainfall of over 20″. We have a very fine system of inland rivers, for instance, there is the Murray, 2,200 miles long with many tributaries, and we are making the most determined steps to harness those rivers and divert the fertilizing streams over the fine arable country through which they flow. The problems of irrigation are not new in Australia ; we have had some 45 years' experience since the first large irrigation settlement was established, but we have reached the stage when we feel the absolute necessity for fundamental and applied research in irrigation to help all those fruit and animal industries which are based on irrigation along the Murray and other river valleys. Therefore, we shall follow with great interest the development of this project for an irrigation research station, and if assistance is ever wanted from Australia you may rest assured that we shall be prepared to make a very substantial contribution towards this most important link in the chain of Empire Stations.

Sir Arnold Theiler (South Africa) : First of all let me dissipate Major Elliot's impression as to the magnitude of the research expenditure at Onderstepoort. It is true that the total sum voted by Parliament for that institution is nearly £100,000, but I want to make it clear that the greater part of this is reproductive expenditure and that only about one-third of the total can be credited to investigational work. Apart from its research activities Onderstepoort is also a factory for the production of laboratory products such as sera and vaccines, and from this activity alone there is a direct return to the Treasury of about £30,000. In addition to the sale of products, anthrax vaccine is issued free to the farmer in order to encourage the stamping out of the disease. If this vaccine were charged for at the minimum world market rate, there would be a further direct revenue return of over £35,000. The institution also undertakes an enormous amount of routine diagnostic and advisory work, which cannot be reckoned as research, and at the same time undertakes the vocational teaching work for the Faculty of Veterinary Science in the University of South Africa. The research workers lecture in their special subjects, as already pointed out by Dr. du Toit. The real total expenditure on research activities is not more than £30,000, a sum which numerous other research institutions throughout the Empire would not regard as excessive. In thinking of Onderstepoort it should always be remembered that

if all its factory products were sold at current market rates and a small charge made for its free services to the farmer, its revenue would exceed its expenditure, and it would not only pay for its own research, but return a substantial profit to the Treasury. I think Onderstepoort is the best example in the Empire of research as a direct paying proposition.

In regard to general policy in research expenditure I consider it unwise to commence by saying that you have so much money to spend on research and no more. The proper attitude is to try to visualize the economic importance of the problem and adjust growing expenditure according to the needs of the situation and the progress achieved. Research is always a profitable proposition in the long run, and it is the problems of the country which govern the sum you have to subscribe. When I commenced work in South Africa over 30 years ago animal disease was the limiting factor in the rearing of stock. There were big problems peculiar to the country, and nowhere in the world could we go for assistance and guidance. We had to solve the problems ourselves, and in the course of time the laboratories developed according to the magnitude and variety of the tasks presented. I could not have said in advance, " Give us £100,000 a year and we will do the work for you." But as fast as we solved the problems the direct and indirect economic return from their solution became so obvious that the purse strings of the Treasury automatically loosened. My advice would be, " Visualize your problems first, apart from arbitrary ideas of expenditure, and do not be afraid of the future."

In regard to the scheme of a chain of research stations throughout the whole tropical and sub-tropical Empire, I wish to congratulate the promoters of so magnificent a conception. The idea is a great one, but I would like to emphasize the danger of creating the chain on wrong principles unless the specific nature of the problems to be solved is made the determining factor in construction. For example, the suggestion has been made of a research station in West Africa concerned with the local production of oil, with a subsidy proportionate to the export value of the product. The real need for expenditure, however, may not be proportional to the value of the product at all, but to some factor the nature of which we do not know until we visualize the details of the problems presented, and the final result of the investigations may not only benefit West Africa but other parts of the Empire as well.

From the point of view of veterinary science, I would particularly stress this general Imperial aspect of many of our epizootic diseases. I need only allude to rinderpest, which is a constant menace from the East to the whole Empire ; or, to come nearer home, refer to foot-and-mouth disease, which constitutes such an important problem in this very island in which we are now assembled ; but which at any moment might become a menace in other parts of the Empire. In regard to such general Imperial issues certain

overseas territories may offer special facilities for the solution of one type of problem, and other territories for the solution of another. One country may be suitable for the study of a disease the investigation of which would be dangerous in another country. One problem may require field experimentation on a large scale with cheaply procurable animals, another demand intensive work on few animals but with expensive laboratory equipment. Each unit of the chain of research stations should, therefore, not only deal with the solution of the local problems of the geographical area in which it is situated, but should co-operate in any problem for which it possesses the required facilities. We must not visualize the chain as a series of scattered links, but as a co-ordinated scientific whole serving the great ideal of Imperial research.

Needless to say, any proposal for establishing a chain of research stations throughout the Empire must, particularly in veterinary science, involve the strengthening of the veterinary research stations in Britain itself. As a critic from overseas I may perhaps be allowed to express the opinion that veterinary science in Britain has been the neglected sister of medical science, but I sincerely hope that Cinderella will find her prince at this Conference. Strong British stations could undertake fundamental work of equal importance throughout the chain, but of a nature requiring the greater facilities offered by a larger community of scientific workers. They would also be peculiarly suited to undertake certain aspects of tropical diseases of animals even better than stations in the countries in which these diseases occur. Speaking from my special knowledge of tropical animal diseases, I would even advocate transporting some of these diseases to Britain for experimental study, where such procedure would be safe. For example, almost any of the virus diseases transmitted by specific vectors peculiar to the tropics could be safely introduced without fear of spread, and here serve for fundamental studies of immunity problems.

Reference has also been made to diseases arising from specific malnutrition, and there is no greater admirer of the fundamental Scottish work than myself. But much still remains to be done in direct practical relation to economic conditions occurring in great overseas belts of the Empire. Africa offers great opportunities in this respect, since large affected areas are easily obtainable and animals are cheap. I would like, for instance, to see co-operative work between the Rowett Institute in Aberdeen and other stations throughout the Empire developed as fully as possible. A type of field work difficult to carry out in Britain might be carried out cheaply and easily under naturally occurring conditions in Africa and Australia, while on the other hand a type of intensive study, difficult to execute overseas, might more easily be accomplished at the Institute in Scotland.

In conclusion I might summarize my views by saying that we must always put the nature of the problem in the foreground of

our schemes, and think of it even more than the geographical line of our chain. Each individual station should be concerned not only with its local requirements but with the scientific nature of our group of problems as a whole. The more fully each co-operates, the more economically can we accomplish the tasks presented to us by the Empire.

Mr. R. Hewison (Sudan) : I would like to correct a statement by Major Elliot. In connection with the question of irrigation, he indicated that there was no research station throughout the Empire which was dealing with the fundamental questions involved. As a matter of fact, in connection with the Gezira Irrigation Scheme, the Sudan Government have for a large number of years been carrying out a considerable programme of fundamental research on this subject. At the Gezira Research Farm the Sudan Government, with the support and co-operation, and, what is really more important, the generous financial assistance, of the Empire Cotton Growing Corporation and of the Sudan Plantations Syndicate, have established a research station which has involved a capital expenditure of some £40,000 and an annual budget of something between £8,000 and £10,000 (I have not the actual figures by me). One of the principal functions of this research station was the working out of problems in connection with the water added to dry land, the movement of water in the soil, the movement and concentration of salts in the soil and their effects on the subsequent yields. This research station was started originally in 1918, and has only recently been brought into what one might call proper condition. It is now well equipped with laboratories and houses, and has attached to it a farm of 350 acres.

Sir John Russell, in speaking on the question of interchange of research workers, mentioned the fact that the experiment had been tried at Rothamsted of sending out a research worker to the Sudan. He actually worked with us on soil problems in connection with the physics of the soil generally, movement of water and other subjects in connection with irrigation schemes. We found that his presence there was of the greatest help to us, and I am assured by Sir John Russell that it has also been of considerable assistance to Rothamsted. In connection with the methods and the lay-out of experimental plots we found Dr. Crowther, who was the scientist in question, of the greatest help, and our programme, as the result of his visit to the Sudan, has been entirely revised.

On the general question Sir Arnold Theiler has rather struck a note which has appealed to me throughout this Conference. He discussed the question of problems. We have all rather been thinking about the necessity for scientific research. No one will question that, but I think that before a more comprehensive and really useful scheme of agricultural research can be applied to Empire agriculture a survey of agricultural problems throughout tropical and sub-tropical countries is required.

Dr. F. J. F. Shaw (India) : I am sure this question of a chain of research stations in the tropical and sub-tropical Empire is one of very great importance, and of very great interest to India. I must confess that at the present moment I do not see exactly how a country such as India will link into this chain, but I have no doubt that administrative difficulties will be overcome, and that we shall eventually take our place in the scheme.

It might be of interest to the Conference if I sketched briefly the organization for agricultural research which at present exists in India. We have a research station, as you know, at Pusa, which is directly under the Government of India, and we also have research stations in each of the provinces. The research stations in the provinces are administered and managed by the Local Governments of those provinces. At Pusa the Research Institute is divided into seven sections—agriculture, chemistry, mycology, entomology, botany, bacteriology and a section which I might term a section of administration since the Headquarters of the Agricultural Adviser to the Government of India are situated at Pusa. In each of the scientific sections there is a staff which consists, in theory, of two officers of the Indian Agricultural Service—in practice for some years past, owing to economy, there has been only one such officer—and about five Indian officers of the Provincial Service and Lower Service. The Indian Officers are graduates of Indian Universities.

The cost of each section at Pusa is, roughly speaking, about half a lac of rupees, except in the case of the agricultural section, which is probably about three times that. The total cost of the Pusa Institute is probably somewhere about six lacs of rupees, i.e., about £40,000 to £50,000.

The duties carried out at the Pusa Institute are, first, research ; secondly, post-graduate training. It is the function of Pusa to train Indians for posts in the Indian Agricultural Service. With this object, there is a selection board held every year to select suitable candidates for training. The standard which we demand of the candidates is that they shall possess a first-class honours degree from an Indian University in the particular subject in which they propose to specialize, that is to say, if we are going to take a student for mycology or for the botanical section, we expect him to be an honours M.Sc. of some Indian university. The period of training is for two years, and the number of students that can be taken in each section in any year is limited to two. There is no guarantee whatever of employment at the end of the period of training.

At the provincial colleges, the work is very much the same as that which I have just described at Pusa, except that the research work will, of course, deal more with the local problems of the provinces, and the training of students is taken up to graduate standards and is not generally of a post-graduate type.

We have in India, therefore, eight or nine agricultural research

stations scattered over a very large country indeed, and representing almost every possible condition of soil, climate and crop. I cannot myself imagine any one of these units serving the purpose of a station in the chain of research stations. No one place could possibly be representative of India as a whole. Possibly Pusa comes nearest because we can grow in Pusa most of the crops of Northern India, and we can also grow rice, but the idea which occurred to me was that we might enter the chain of research without necessarily having any one particular research station nominated as a unit in that chain. A problem, for instance, which is being studied in research stations in the system under the Colonial Office might be taken up and studied at any particular research station in India at which the conditions of soil and climate render that study possible and profitable.

A good deal has been mentioned at this afternoon's meeting about irrigation. That is a subject which has received a very great amount of attention in India. It is one on which I am not qualified to speak myself, but I hope my colleague, Mr. Milne, who is Director of Agriculture in the Punjab, will be able to say something.

Mr. D. Milne (Punjab) : I will confine myself principally to this matter of irrigation, as time is going, and perhaps one may be able to say more at a later meeting. The Punjab has an area of about 97,000 square miles, that is, it is a little larger than Great Britain. In the province we have the Himalayan Hills in the north-east and north-west, and the five rivers of the Punjab, from which the province gets its name, flow from these into a flat arid plain which forms the main part of the province. June is our hottest month. The average monthly maximum temperature in June is, I think, about 108° F., while in December and January, which are our coldest months, the average maximum temperature is 70° F. or thereabouts, with a minimum temperature of about 40° F., getting down to a few degrees of frost occasionally. As regards rainfall, we have about 5″ per annum in the south-west corner of the province, and it increases gradually as you near the hills, until in the Himalayas we can get over 100″. There are about 17 million acres of land at present commanded by existing canals in the Punjab, of which about 11 million acres are irrigated annually. Schemes have been passed by Government for irrigating an additional 8½ million acres, and schemes to irrigate a still further 8½ million acres are under consideration, I believe. The first of our canal colonies is about 30 years old, and many problems have arisen in regard to the application of water to these arid plains in that time, among others the Irrigation Department, the Agricultural Department and people in general have been faced with questions of waterlogging, appearance of salts on the surface of the soil and so on. At the present moment the Irrigation Department has a research officer who has specialized in soil physics, investigating some of these problems, but it is realized that that is not anything

like enough. As regards agriculture a very great deal has been done in the last few years in the way of development of that department, which, in the Punjab, includes veterinary matters. A five years' programme of development was drawn out two years ago; we are in the second year of it, nothing having been refused, and, as far as I can see, it will all go through. It involves the expenditure of about a crore of rupees, that is about ten million rupees, about 14 rupees going to the £. That programme has been generally blessed by Government, but, of course, every item has to be fought out in its turn as it comes up. In that scheme there was a proposal to start a Hydraulic Station at Lyallpur, in the middle of the oldest colony, where we have the Agricultural Research Institute. That Institute is staffed with about five or six botanists (including men on cotton, wheat and other cereals, fodder, fruits, &c.), an entomologist, chemists, a bacteriologist, and so on, and the staff will be added to as the years go on, according to the programme which we have laid down, and I hope for something even in addition to that. I have already got 500 acres of land available for this hydraulic station and the proposal is that we should have irrigation engineers to work with agricultural officers, soil physicists and people of that sort, a team of men, in fact, which would be able to tackle thoroughly the problems that have arisen in our thirty years' experience of irrigation. I feel sure our Government would consider very favourably any proposals to have an irrigation research station in the Punjab if suitable assistance were given, and personally I think that with the accumulation of experience which our irrigation officers and our agriculturists have of the problems there that it would be a very suitable place indeed in which to have such a station.

Mr. W. Nowell (Amani): As I have only recently been appointed to organize the Central Research Station at Amani, and have had no time to produce results for exhibition, I should prefer to listen to the counsel of those present rather than to bring forward my own views on the subject. It does happen, however, from the accidents of my career, that I have been in touch with the general subject for a long period. Like some others present I was associated for a number of years with the Imperial Department of Agriculture in the West Indies, which offers in some directions at any rate perhaps the closest parallel that can be found in the Colonial service to the functions which it is proposed the central research stations should take up. Then again I have been at a later period a spectator, disinterested in one sense and deeply interested in another, of the development of the Imperial College in Trinidad. My main point in regard to the latter has already been put forward by Professor Shephard, namely, that if the advantages which are to be obtained from the association of teaching and research are to materialize it involves the adequate staffing of the institute for all purposes. I cannot subscribe to the opinion that it is any advantage for a man who is working on a problem to have to teach the subject at the same

time. I can, however, agree that if the staff is sufficient there may be advantages from the contact with practical problems that teaching implies. The guiding principle of the Imperial Department of Agriculture, at least during the time I was associated with it, was this: that while a staff of officers were kept at the service of the group of colonies involved they were only sent out in response to requests from the Departments of Agriculture or from the Governments who needed their services. I entirely agree with the views that have already been expressed in some of the literature which we have received that a central research institute must in no sense enter into competition with the local Departments of Agriculture, but must supplement them in directions which they are unable to pursue and co-operate with them in problems in which both staffs can find adequate work to do. The chief question it seems to me in regard to central research stations which could profitably be discussed by this Conference is their functions. Like a previous speaker I have had difficulties with the word "fundamental" as applied to research. I take it from the association of the Empire Marketing Board with this project for research stations that some profitable results are looked for, if not immediately, at any rate before any great lapse of time, and it is difficult in a group such as the East African colonies, for example, to conceive of fundamental research which shall have very much practical bearing on agriculture in a country where so far as the natives go agriculture is necessarily primitive, and so far as the European settlers are concerned, is only now beginning in spots to emerge from the inevitable first phase of mere exploitation of the soil. The word "fundamental," even the word "research" without the adjective, will have to be taken in a wide meaning if the central research stations are to exercise the greatest possible usefulness that lies before them. I have just returned from a hasty survey of the six colonies and protectorates which form the East African group, and the most noticeable thing in regard to them, viewed in their relation to the possible central station, is the diversity of the services which they require. The Imperial Department of Agriculture, to which I have previously referred, has been in exactly the same position. There were small colonies in the group which required the services of all kinds of specialists in agricultural science from time to time. There were others which were adequately staffed with their own scientific men, and only needed the visit of a specialist on occasion to advise on some specific problem. Exactly the same situation occurs in East Africa. There are territories which have few or even in some cases, no scientific officers on the biological side. There are others, such as Kenya and Uganda, which have a full complement of officers, and the services which are expected by those two different types of territories must necessarily be different in kind. Then again, in regard to the actual work of the Institute there are general matters in which the advantages are obvious, I think, of an institution which

has an East African rather than a Tanganyikan and Kenyan point of view, and there are large services in the direction of co-ordination of knowledge and the co-ordination of information between the different territories which would be of primary usefulness in the development of the agricultural services, but perhaps could not be described in the phrase " fundamental research " except under a very broad interpretation of it. I have no doubt whatever, without entering into any programme which I may propose for the work at Amani, that there are a number of most useful functions which it can carry out and that the work will develop in contact with the work of the different Departments of Agriculture, and that a complete and useful function can be found for the institution.

In conclusion I should be sorry if the establishment of central research institutions were to preclude the possibility of grants being made in some instances to special work that can be carried on in a particular colony. I am not referring now particularly to East Africa, though I daresay instances can be found even there, but in the case of, say, the proposals put forward by Mauritius where important sugar research work, mostly of interest to the colony itself, but certainly having a wider application to other colonies interested in the same problems, is carried on, it ought to be possible, I think, apart from central research stations, for grants to be made in aid of local research where the opportunities are specially suited for it to be carried out.

CHAIRMAN: I cannot help thinking that it must have been passing through some of your minds, it has certainly passed through mine, since Major Elliot spoke, that before we ask any Commission to draft the details of a chain of Imperial research stations, we ought to have some definite idea as to what we mean by a research station for this purpose. Now, Mr. Nowell has raised questions which have been adumbrated by Major Elliot first of all as to whether these Institutes are to be Institutes of fundamental research, and if so, what we do exactly mean by fundamental. Secondly, this question has been raised in a most emphatic way in a memorandum which has come from Nigeria, as to whether and to what extent research institutes should also undertake teaching. I am wondering whether, in the absence of Mr. Faulkner, any of the three delegates of Nigeria would like to develop the latter subject. Of course, you may say it is more a matter for the Commission to deal with, but I rather think we ought to refer something definite to them as to what is the work of stations of which we desire to see a chain.

MR. P. H. LAMB (Nigeria): In the absence of Mr. Faulkner, the Director of Agriculture in Nigeria, I am here particularly to stress his view which is to be found on page 25 of Memorandum No. 2. He emphasizes the fact that in his opinion research stations should as far as possible be made also teaching institutions or central

colleges. From what has passed this afternoon it seems perfectly clear that no very hard-and-fast line can be drawn in the first instance as to the form these research stations should take. In the West Indies, in the case of Trinidad, it has already taken the form of a college. To some extent that is the case in India too. It is our view that the same should undoubtedly be the case in Nigeria. If these central research stations are formed, the question is how can they be made most useful, and our view from Nigeria is that the work of the research officers or the specialist officers in the different departments is very much hampered by the fact that their native assistants are so extremely inefficient. They compare very badly with those in India and Malaya, but the raw material is there, and it remains to be developed. It is not within the power of every individual colony to bring those assistants up to the required standard; all that the colony can do is to prepare the material for the college. I should make quite clear that there would be no intention whatever of such a college in West Africa teaching any European students, but purely and simply to train the natives of West Africa, as it is in India to train the natives in India, to be members in the first instance of the Agricultural Department, and as assistants. This arrangement has proved satisfactory we have been told by Dr. du Toit in South Africa; the combination of research work with teaching has there proved an entire success.

What one hopes to avoid is that the central research stations should in any way overlap with the Agricultural Departments. The central research stations would be concerned with certain problems which would not be within the reach or means of the local Agricultural Department. It seems to me that one of the principal functions of the Advisory Committee at home would be to say where problems of Imperial importance can best be tackled. Now, British West Africa contains extremely varied conditions, as we have been told Australia does, India does, and even the West Indies. It borders on the Sahara, with a rainfall of 15 inches in the neighbourhood of Lake Chad; it extends down to the mandated territory of the Cameroons, with a rainfall of 300 inches, so it seems fairly clear that no research station situated where you may choose in West Africa could tackle all the problems even of West Africa, but undoubtedly a station suitably situated in West Africa could solve there certain problems probably better than elsewhere in the Empire. Certain of our problems can perfectly well be solved elsewhere: for instance, as Mr. Hewison has pointed out, in the Sudan they have there conditions of a kind which he has described, and with which I am to some extent familiar, which correspond very closely with those of Northern Nigeria. We are just beginning irrigation work there, but our irrigation is on a minute scale compared with the Sudan. We should not propose a research station in Nigeria for irrigation work, but should like the Sudan to tell us what we want. Our conditions are to some extent similar, we are in a similar latitude,

and their rainfall is not very dissimilar, so it would seem probable that one of the principal functions of this Advisory Committee would be to say where the research could best be carried out, and as regards the actual research stations themselves these must vary considerably in nature and it would seem quite logical and reasonable for the central pool to send men to carry out central research work, not necessarily at any central research station. Use could be made of existing institutions for doing research work, which would be tremendously to the benefit of such local institutions.

Sir James Currie: I have read Mr. Faulkner's memorandum with the attention that it deserves. Does he propose to start the station as a teaching institution now, or has he got to wait until he has built up some sort of system of secondary education to enable your people to benefit from what you give them?

Mr. Lamb: We have already started an agricultural school, but it does not profess to do the advanced work such as we should like to see done and the men we turn out from that college would be very inferior to the senior native assistants of India.

Sir John Farmer: While you cannot give a satisfactory definition of "fundamental research" there really is a sort of commonsense delimitation of fundamental, or call it long range research—i.e., lines of research which, if they are to be prosecuted usefully, must go on for a long time. Take the case of the selection of coconuts. We have a great deal to learn about the genetics of the coconut, and a lucrative future should be assured to the industry as and when the various problems concerned with its genetics are solved. Many other examples could be quoted, but this will serve as one example of what is implied by the term "long range or fundamental research." It is, however, clear that it is useless to expect anyone economically to tackle a complex problem of this sort unless he has an instinct for research disciplined by sound training. You must have a first-class man on the job, and one who knows genetics from top to bottom, and with experience as wide as possible. Looked at from these points of view, I hope that we may accept it as an explanatory illustration of the sort of work that can usefully be done at a central research station.

The question has been raised about the possibility of a single station suiting different kinds of work. Now, it is quite obvious that coconuts could not be grown for research or any other useful purpose in many places even in a single colony. But if coconuts were grown at all and formed an industry in the region, nothing would be easier than to have sub-stations. Indeed, they will probably always be necessary.

There is another matter. I can quite imagine that some sort of apprehension may be felt as to the degree in which these research stations might be supposed to trench upon the proper duty of Agricultural Departments. I think that it is quite possible that

some parsimonious Government might think if they had access to a research station it should release a certain amount of money from their Agricultural Department which might be used for quite different purposes than to maintain specialists of any sort. I think you gentlemen probably would not agree to that aspect of the matter. If we agree, and I think we can agree, that what we call long-range work is the primary work of the central institute it is at least equally clear that the investigational and advisory work of the Agricultural Department must also be maintained, with the necessary scientific staff. It is not good policy to take a man who is engaged in a particular long-range problem off his job and expect him to be at the beck and call of anyone who may have an outbreak of disease in his plantation. That is, at any rate, in the first instance, the proper function of the Agricultural Department, whose business it is to deal with those administrative scientific aspects and to have a staff which is adequate to cope with routine problems. The staffs of the central research institutions are not going to conflict or to compete with, still less to replace, the scientific Agricultural Officers, but to help the Agricultural Departments as a whole in work which the departments themselves have neither the resources nor the facilities for undertaking. I think this fairly represents what those who have been thinking about the problem as a whole and who have brought the matter before you have had in their minds. We know that there are many problems, and I am quite sure that every Director of Agriculture here must be able of his own experience to recall examples, which he would be glad to get rid of and remit to specialists for investigation and solution. His own staff, liable more or less continually to interruption owing to the various calls on their time at the instance of planters, simply cannot tackle that kind of work. I know quite enough about the attitude of mind which is required for successful prosecution of long-range research to realize that often a man who is competent to undertake work of this kind may be temperamentally unsuitable for administrative advisory work. He is apt to be thinking about his own job all the time, and a research genius is often by no means the best man for departmental work.

Finally, there is the further question of the relation of teaching to research, which has been adverted to at length in the able memorandum of Mr. Faulkner, and I know it is present to the minds of various others as well. You will possibly have looked at the Lovat Committee Report, and there you will see that the idea of the Committee, who have taken a great deal of evidence from some of you gentlemen, amongst others, is that on the whole the teaching side of the work, at any rate what we may call the undergraduate teaching work, ought to be excluded from the sphere of work proper to a research station. There should probably be a certain amount of discretionary latitude, and, indeed, I think there is actually contemplated—certainly I should contemplate—the possibility

of a limited amount of what might be classed as post-graduate teaching being allowed, teaching that is intended to train men to think on research lines; but for the purposes of these Institutes, which, after all, are limited by a rather narrow range of finance, and are to be charged with functions that for their proper discharge will leave them with a very small margin, any attempt to saddle them with ordinary teaching work such as is the proper duty of an agricultural college or school would, I think, be disastrous. It is another matter when you get the man, as in India, who may have already taken his degree and thinks he has a flair for research. There is no harm in such a man, if suitable, coming to a research station and being given a job which will give him experience in research under skilled guidance. But even this ought not to be a *primary* function of the Institute. I will end with a repetition of the warning that it would be a fatal mistake, having regard to limitation of resources, to start at the wrong end of the business, by putting teaching first and research second. Indeed, the essential work and development of an Institute might be very seriously hampered if it were *insisted* that teaching of any sort must always form part of its duties.

Sir Herbert Read (Mauritius): I do not feel justified in expressing an opinion on the more technical side of the question, but I think it might perhaps be useful if I said a few words in amplification of the Mauritius memorandum, which is among the papers circulated at this Conference. That memorandum was prepared by the Director of the Mauritius Department of Agriculture, who has great knowledge of the sugar industry, and has done a great deal of original research work in connection with the sugar problem. The Agricultural College of Mauritius is concerned with both teaching and research. Its annual budget is about £9,000 a year. The revenue is provided by the sugar industry by means of an export duty on sugar. Provision is made there for the teaching of entomology, mycology and chemistry, and there is also a veterinary officer, a sugar technologist and a statistician. We have also an irrigation question in Mauritius. At the present time there are two large irrigation reservoirs and we are now constructing a third one with a dam over a mile long, and we are proposing to appoint a special Irrigation Officer. One point that the Director of Agriculture laid emphasis on before I left the Colony was that Mauritius was specially suited for the study of soil problems. As far as the College itself is concerned, there are excellent laboratories there, and the building stands in quite a pleasant part of the island. In addition to the teaching and research work relating to sugar a certain amount of investigation work is now being carried on with regard to tobacco and certain other tropical products. I understand that in the past Mauritius has supplied South Africa with a number of technical experts, and I have no doubt that, with increased funds, its sphere of usefulness could be considerably extended.

There is one point I should like to mention. The idea has grown up in this country that the Colony of Mauritius is unsuitable for English-speaking people. That is quite a mistake. The students who attend the College are bi-lingual, and in any case, the instruction is given in English.

Mr. W. G. Freeman (Trinidad) : I would like to say a few words about the relationship of central research stations and local departments. It has been touched upon by several speakers. I approach this question from a slightly different angle because, like Mr. Nowell, I am an old member of the Imperial Department of Agriculture for the West Indies, and at the present time I am in close association with the first of the new central research institutions, the Imperial College of Tropical Agriculture, located in Trinidad, in the capacity of being, first a governor of the College, and secondly, Director of Agriculture in that Colony. I think the view we all hold, and it has been expressed this afternoon, is that these central research institutions shall be primarily complementary and supplementary to the local departments, and that local departments shall be allowed to carry on their work to the best advantage. We, speaking for a large number of agricultural Colonial officers, are rather in the position of general practitioners, having to carry out our duties as best we can with our resources, and when we meet problems which we have not sufficient staff to deal with, we want at hand, and we have felt the need for many years, a body to whom those could be referred. If these problems are being considered purely by a group of scientific officers in the colonies, or by a general advisory or other agricultural council that may be set up, I think there should be no difficulty, but when you come down to actual practice, and I am speaking now from personal experience, we know that in the colonies we come up against our local legislatures and particularly the unofficial sides of them, which often have a great deal to do with determining what amount of money is to be spent on the various projects. To put it shortly, the view that is now being held in Trinidad is that the Imperial College and the Trinidad Department of Agriculture are not complementary bodies, but are alternative bodies. To give you a specific instance. Mr. Nowell recently left my Department to take a cursory survey of British Guiana before he went to Amani. The result immediately is for the local Finance Committee to abolish his old post of Assistant Director and Plant Pathologist on the grounds that the College now being in our midst the Department has no need of such an officer. Similarly, although the Department went out of its way to give every facility to the College, even part of its lands, we had closely adjacent to them our little Naboth's Vineyard, a sugar experimental station, and just recently they have decided that they want more land for their purposes and they consider there is no land so suitable as the sugar experimental station of the Department, and negotiations are now in progress for them to obtain that

station. The Department then will lose the whole of its facilities for carrying on any field work in relation to sugar, which is one of our two principal products. I am not putting this forward as merely a theoretical difficulty, but one which has actually occurred, and I would ask for the lead of this Conference, which would be a very great advantage to both sides. Professor Shephard dealt with the danger of the College having work that was not primarily theirs loaded on to them by these local Legislatures. I quite admit that. There is also the danger of the local Department being robbed of facilities for doing part of their proper work. That will also rob them of that prestige which is necessary to a Department of being a bit in advance of the planters. I do not know how true it is here, but those officers who work in the Colonies know that it is often very difficult for a Government Agriculturist to acquire very much honour in his own country, and if you rob us of facilities for doing our proper work it will make it still more difficult. I would, therefore, urge that there should be laid down for the benefit of local Legislatures and for the direction of local Departments and of new Research Institutions what are their proper lines of work, because if we have something we can quote as the view of such a representative gathering as this, it will be a very great help. I would also suggest that perhaps some indication might be given that when research institutions are formed in a territory, while you want a close link between the Central Advisory Council at home and the work of the research institute, there should also be some simple form of machinery set up for securing co-operation between the research institute and the Department of Agriculture in the domain served by that research institute. I can imagine, for instance, that if you call together once a year, say the head of the Trinidad College and the Directors of Agriculture in the West Indies Colonies which come within the area served by the College, they could jointly draw up a scheme of work and prescribe how it could best be carried out, and that would have a good deal more weight than if the College did it independently; it would be very helpful for all concerned, and lead to fuller co-operation.

Colonel G. N. Williams (South Africa): The Government of South Africa is quite sympathetically inclined to this proposal for a chain of research stations, although, at the moment, it is rather difficult to conceive how exactly it would work. We shall be going into the matter fully in Committee. We do desire to participate, and since, of a total annual expenditure of roughly a million on agriculture, we are spending one-eighth on research, I think you will agree we have naturally a pretty live interest in the matter. The research work which we carry out is almost entirely in the nature of what Sir Daniel Hall has called administrative research. Free research is done only to a very limited extent. We hope that will be developed more at the two Universities which possess faculties of Agriculture. It is in that direction we are moving, but we think

that this chain of research stations has certainly great practical value. The difficulties that arise, of course, are mainly administrative, in regard to the control of such stations : that is the question upon which we would like to be very definitely informed before we can decide whether we will participate in such a scheme or not.

I would like to say one or two words in regard to the research work we are carrying out in South Africa at the moment. As regards the veterinary research, it is unnecessary for me to say anything ; that is pretty well known. There is a good deal of research in regard to botanical matters going on. My colleague, Mr. Storey, has done some very important work in regard to virus diseases of plants, and we have several stations at which research work into plant life is going on. We are now establishing, and the Government intend to spend a very considerable amount of money on, a research station for work on sub-tropical horticulture, and more particularly in reference to citrus fruits. We are going to establish a real station, not a little affair, and we are going to spend money on it. In regard to irrigation we are also carrying out a good deal of research work. Irrigation did not fall within the province of the Department of Agriculture at all. As a matter of fact, up to the present, or to within a month or two ago, it fell under a separate Department, with results which, to say the least of it, were very regrettable. However, it now forms a portion of the Department of Agriculture, and we are getting very much better co-ordination. Experiments are being carried out now in regard to the duty of water. We are carrying out research work into agricultural economics as to what crops can be most profitably grown on small-holdings, and what the areas of those small-holdings can be. Naturally, we have to have more than one station for that purpose, on account of the different physical and climatic conditions in the different parts of the Union.

Then again, we have two faculties of Agriculture in South Africa. One is, for administrative purposes, entirely under the Department of Agriculture, although for academic purposes it is under the University of which it forms part. At that University there is a considerable amount of research work in all branches of agriculture. Then at Pretoria we have the Transvaal University College, which possesses a faculty of Agriculture and forms part of the University of South Africa. There also a great deal of research work is being carried out, and as we control the purse we are able to call the tune. The result is that we get perfect co-ordination between the various heads of divisions of the Department, and the departments of the faculty. That is a rough sketch of the means at our disposal in South Africa for carrying out research work.

Mr. A. S. Haynes (Malaya) : Malaya has a very great interest in long-range research. At the present time it lives mainly on rubber. A somewhat restricted life it is true, but it is living fairly well. It is absolutely essential, as we found two years ago at the

time of the slump, that further crops should be grown to take the place of rubber and to widen the economic basis on which the country rests. Our further crops are mainly at the present time coconut oil palms, and in respect of those some research is being conducted by the Department of Agriculture, but they are subject to long delays, and, in my opinion, it would be most suitable for such long-range research to be carried out at some central research station. What I would particularly like to urge on behalf of Malaya is research in the matter of irrigation, and also veterinary research. My main reason for that is that they affect the native population of the country, namely the Malays, and secondly, because in irrigation we touch on the question of rice, which is food production and a matter of vital interest to the country. During the time of rice shortage some five or six years ago, within a very short period the Governments of the Federated Malay States lost as large a sum as forty-two million dollars on their rice purchases, and even that does not take into account the loss which accrued to the Planting Companies, who had to buy rice at the high prices which the Government had to charge.

As to the place where the research station should be established, I should naturally like to urge the claims of Malaya, but I do feel the question is one for broad consideration on Imperial lines, and it appears to me that the decision on such a matter is one that might be properly left to the Agricultural Research Council which it is hoped to establish.

The questions of irrigation and veterinary research, as I say, affect the people of the country, the Malays. The Malays live very largely by their rice production, and for that purpose water control is necessary. By irrigation I do not mean the bringing of water on to arid tracts, because we have few such arid tracts in Malaya; what I do mean is control of the water, getting the water on to the land when it is needed, and getting it off when it is not needed. In the matter of veterinary research, the Malays are touched on a vital spot by the rinderpest, which so often causes them serious losses in their buffaloes; those buffaloes are used for rice cultivation, and at a time of rinderpest, when the movement of buffaloes is restricted and losses occur from disease and by the destruction of animals which has to be undertaken by the Government, terrible hardship is caused to many of these people which it is impossible for them to get over in many instances without Government assistance.

Mr. A. Holm (Kenya): With regard to the Veterinary Research Institute situated near Nairobi: that Institute is already well established, and it ranks to-day as one of the three large veterinary research institutes in the Empire, those being Pretoria, Muktesar in India, and Kabete in Kenya Colony. It was established by the Kenya Government at a cost in capital expenditure amounting to about £50,000. Its annual recurrent expenditure is in the

neighbourhood of £28,000 to £30,000. As at Onderstepoort, considerable revenue is derived from the sale of sera and vaccines. That revenue amounts to about £25,000 or £26,000 per annum. It has been estimated that in order to equip the institution as a central research institute for East Africa an additional capital expenditure of about £50,000 would be involved. I regret to have to say that from some points of view Kabete is very well situated in respect of investigation and research work on sub-tropical diseases for the reason that there are present in the country so many of the stock diseases which are to be found in tropical and sub-tropical countries. A great deal of research work has already been done which has covered those diseases caused by ultra-visible virus, those caused by protozoa, those caused by intermediate hosts, and those caused by specific bacteria. At the Conference of East African Governors, held about eighteen months ago, that Conference passed a resolution approving in principle that a central veterinary research institute for the East African Colonies and Dependencies should be established at Kabete. Another aspect of the question now before us, a suggestion more recently made, is that this Institute should be used as one of the central Veterinary Institutes for Imperial purposes. I am not in a position to speak with the authority of the Kenya Government in the matter because the subject has not been before the Kenya Government, but I have had conversations with Sir Edward Grigg, the Governor, and I believe both he and the Kenya Government would favourably consider a proposal that the Veterinary Research Institute at Kabete should be used for Imperial purposes.

5.—Imperial Bureaux.

Thursday, October 6th, 1927.

Rt. Hon. W. G. A. Ormsby-Gore, M.P. (Under-Secretary of State, Colonial Office, and Empire Marketing Board) : In the report of Lord Lovat's Committee on Agricultural Research and Administration in the non-self-governing Colonies, published this year, I note on page 32 the following conclusion : " Existing arrangements for collecting and disseminating reports on agricultural work carried out in the Colonies, Protectorates and Mandated Territories are entirely inadequate." The report goes on to explain that while this is so, generally speaking, a welcome exception is to be found in the cases of entomology and mycology, and on page 34 it is stated : " We consider that the methods adopted by these two Imperial Bureaux are admirable and provide a model for any similar work which may be undertaken in connection with agriculture outside these two special branches." They go on, on page 36, to state : " We have considered the question of establishing separate bureaux for plant breeding and soils. We think that the formation of such bureaux on lines similar to the existing bureaux would be of great value,

although we realize that the question of finance may render their immediate establishment difficult."

These three quotations make a fitting introduction to the very important subject which, in my opinion, should form one of the chief preoccupations of this Conference. Before embarking on a discussion as to what further bureaux should be established, I had better summarize the functions and constitution of the existing bureaux, although the majority of my audience are, no doubt, fully aware of them. The first of these organizations to be created was the Imperial Bureau of Entomology. It was founded in the year 1913 for the purpose of encouraging and co-ordinating entomological work throughout the Empire in relation both to human and animal diseases and agriculture. The Head Office is at the Natural History Museum, South Kensington. There is a salaried Director of the Bureau, Dr. G. A. K. Marshall, and an Assistant Director working under him. There is an Honorary Committee of Management with a lay Chairman, Lord Buxton, who, with some 15 or 20 members—all men of science—are responsible for guiding the destinies of the Bureau. Contributions for the maintenance of the Bureau amount approximately to £12,500 per annum—that is apart from the parasite branch—and are made up by the Government of Great Britain, the Governments of all the self-governing Dominions, the Government of India, the non-self-governing Colonies, the Anglo-Egyptian Sudan, and the British North Borneo Co. The Bureau publishes a quarterly Journal, entitled "The Bulletin of Entomological Research," and a monthly Journal entitled "The Review of Applied Entomology." This is published in two parts, namely, (1) medical and veterinary, and (2) agricultural, and it summarizes all current entomological literature and publications bearing upon this subject. Some idea of the size and importance of this latter work may be gained from the fact that in the year ending 31st March, 1925, the Imperial Bureau of Entomology published extracts of 2,514 articles from some 1,200 periodicals in various languages gathered from all parts of the world. I can bear witness from personal conversations with entomological workers, both in Great Britain and in many parts of the Colonial Empire, that this monthly journal is regarded by them as of the utmost value, and it serves to keep the research worker in the entomological field in up-to-date touch with what is going on in other parts of the world.

Apart from the value of this publication there are three great benefits that have accrued from the establishment of this Bureau. In the first place, all entomological workers in the Empire have a centre with which they can correspond on scientific problems confronting them, and the Bureau is a means of bringing them in, and to a remarkable degree enthusing men and women engaged in entomological work.

The second great advantage is that it has provided simple and

efficient machinery for the holding of two very successful conferences, one held in 1920 and the other in 1925; at each, entomological workers from all parts of the Empire attended and got to know each others' problems.

The third indirect consequence of the Bureau, which is of no less importance and value, has been the assistance it has given towards the recruitment of a more satisfactory stream of entomological workers, and the giving of advice to the various Governments and Government Departments of Entomology requiring entomologists as to who is the best man or woman that can be obtained for the purpose in view.

The same summary might be added in the case of the younger bureau, namely, the Imperial Bureau of Mycology, which was founded in 1920, as the outcome of a unanimous proposal of the Imperial Conference of 1918. This bureau is in the charge of Dr. E. J. Butler, late Director of the Research Institute at Pusa in India, and its headquarters are at Kew.

The Imperial Conference of 1926 passed the following resolution :

> " This Imperial Conference records its appreciation of the valuable work done by the Imperial Bureaux of Entomology and Mycology, and notes with pleasure that the Empire Marketing Board has made a grant to the Imperial Bureau of Entomology for the establishment of a new laboratory for the breeding of beneficial parasites."

I think you will all agree with me that our experience of the value of these two bureaux is a clear indication to this Conference that it should examine forthwith whether further bureaux can be financed and staffed, and in which branches of applied science there is the greatest need for such an extension of the system.

To my mind the success of a bureau must depend primarily on getting a man as Director who, by reason of his knowledge and experience, is capable of conducting the bureau successfully.

As a result of discussion in the Research Sub-Committee of the Imperial Conference of 1926, I personally became satisfied that the bureau system lends itself more particularly to the co-ordination of work and workers, and of information, in clearly defined fields of applied science. It is, for instance, doubtful whether, however desirable it may seem at first sight, a bureau attempting to deal with veterinary science, generally, could be conducted successfully. The field of work is too big and too varied to embark on anything so comprehensive at the present stage of our development.

I have heard it suggested that the comparatively new science of biochemistry, which is obviously destined to play an increasingly important part in the problems of pure and applied biology generally, should be considered, and that the biochemists throughout the Empire should be linked up in the same manner as entomologists. On consideration I am very doubtful whether this is either practicable

or desirable. In fact we have to consider, first and foremost, the distinction between what may be roughly termed "pure science" and "applied science." In the field of pure science the work of interchange of information is probably best left to scientific associations of a voluntary character in each of the larger countries of the world, on the lines of the Geological Society, the Chemical Society, the Physiological Society, &c., in Great Britain.

My attention, therefore, will be in the main given to an examination of those fields in which workers who are dealing with clearly defined fields of applied science are engaged under the various Agricultural and Veterinary Departments in different parts of the Empire.

In a paper I prepared on Agricultural and Veterinary Research in the Colonies, Protectorates and Mandated Territories for the recent Colonial Office Conference, I pointed out that there were in the employ of the 17 principal non-self-governing dependencies under the Colonial Office 91 agricultural officers (apart from veterinary officers) who may be classed as scientific research workers. Of these 91 officers, 26 are called agricultural chemists, 26 entomologists, 19 mycologists, 18 botanists and plant breeders, 1 soil bacteriologist and 1 microbiologist.

As I have explained, the entomologists and mycologists are already served by most successful bureaux, and it would seem, therefore, that the obvious next step, at any rate so far as the Colonial dependencies are concerned, is to provide two new bureaux, one for the agricultural chemists and one for the botanists and plant breeders.

I will take the chemists first. The agricultural chemists are engaged in the main upon work in two fields. In the first place there is soil chemistry, and, secondly, chemistry in the economic crops, e.g., the oil content of different varieties of oil palm, the yield, &c. It is probable that most agricultural chemists are engaged from time to time on both kinds of work, and a bureau of agricultural chemistry would probably fail to provide just what is required, and that to commence with, at any rate, we should consider not the establishment of a bureau of agricultural chemistry, but rather the establishment of a bureau of soils.

A bureau of soil science would not, of course, be confined merely to the chemistry of soils, though chemistry of soils is of vital and fundamental importance in investigating the problems connected with the mineral, nitrogenous, and other foods from soil for both plant and animal life.

Soil science is, of course, not merely a chemistry question. It is clear that plant nutrition is affected, and so are agricultural processes and cultivation affected, by the presence in the soil of microscopic life such as algæ, protozoa, bacteria, &c., without which the chemical constituents of the soil cannot become available,

and a whole host of problems in connection with the physics and biology as well as chemistry of soils confronts us.

In the British Empire we are, of course, fortunate in having, at Rothamsted, in Hertfordshire, an institute that can claim to be the premier institute for the investigation of the problems of soil science in the whole world, and it would seem to me that the right place for the establishment of any Imperial Bureau dealing with the problems of soil science is Rothamsted. It is already the Mecca of all workers in this particular field, and its publications are of recognized value in all parts of the world. In fact, all, I suggest, we have to do is to enable Rothamsted to deal, not merely with the soil problems of Great Britain, but to make it the distributing centre of knowledge collected from all the soil science workers throughout the Empire to each and every part of it. It would mean adding to the staff at Rothamsted, and to its publications. But you have there ready to hand a first-class library covering most aspects of soil science, and a congregation of active workers in this field who could assist any director of a bureau and his staff.

But I want to make it clear at this stage that there is no reason why the centre of any one of these bureaux should necessarily be in Great Britain. The place of any such bureau should be a matter of quite open discussion.

The other bureau suggested by the Lovat Committee may be termed a bureau of economic botany and plant genetics, or some similar term. But in considering the character of this bureau I want to make a distinction which it is no doubt somewhat difficult to make between the work of the systematic botanist and that of the plant breeder. I think we must all recognize that Kew is in a very real sense already an Imperial bureau as far as systematic botany is concerned. For many years Kew has been the centre, as far as the British Empire is concerned, for the scientific study and classification (taxonomy, I believe, is the correct word) of plants of the whole Empire. But, in the history of agriculture man has selected particular plants for cultivation, improvement and distribution, for his own economic use. The history of agriculture is very largely the history of the development of economic botany. From countless ages the work of the plant breeder has been going on, generally unconsciously—from the days when primitive man first selected the wild wheat of Syria and domesticated it to his uses. From the early days of empiricism in the valleys of the Nile, the Euphrates and the Tigris, and I should probably add the Orontes, to the work of Sir Rowland Biffen, at Cambridge, may seem a far cry, but it is all one long chain of endeavour becoming more and more scientific and of ever-growing importance to human welfare.

The selection, breeding and distribution of the past varieties and the artificial evolution of new and improved varieties of every conceivable economic crop in every part of the Empire is a gigantic

subject, but that is the subject which is contemplated in the establishment of such a bureau for the British Empire.

In Great Britain we have several institutions engaged in this particular work, notably Cambridge, Edinburgh and Aberystwyth. In the Empire overseas wonderful achievements have been made in this field—in Canada, more particularly in regard to wheat and maize. In Malaya corresponding work on rubber and the coconut is being advanced. We hope that the newly revived institute at Amani in East Africa will be able to concentrate on the long range problems connected with this branch of applied science in connection with the crops that are grown in the East African block of territories, such as coffee, cloves, sisal, groundnuts, &c. The work that is going on in this field on rice in India, Ceylon and Malaya is already well known.

The improvement of grass and fodder crops by botanical as well as economic methods is clearly within the field. Then we have all the fruits, citrus, apples, bananas, &c. Viticulture and the like all offer opportunities in different parts of the Empire for research and the work of plant geneticists. We want to attract more workers to this field, the supply is not equal to the demand, and the problems which the workers now have to face involve a knowledge of a rapidly developing branch of quasi-fundamental science, namely genetics. In fact some people are of opinion that to-day it is impossible to separate animal and plant genetics, and that the right course is to be courageously but, in the opinion of some people, dangerously ambitious and start straight away with a bureau of genetics. We live in a post-Mendelian age, and new laws and new factors are emerging of great importance both to the zoological and botanical fields. Personally I am inclined to think that if we could find a suitable man, the most important thing of all, and a suitable place, our best course is to start a bureau of plant genetics.

The mere reference to animal genetics brings me to the veterinary field. In the organization of research the veterinary field is regarded as one of the utmost important, on the one hand to agriculture, and on the other to medicine. I use the word veterinary in what I regard its only proper sense, i.e., as including animal husbandry, animal nutrition, and animal genetics, and not merely the pathology of domestic animals. We must drop the words veterinary surgeon in favour of the word veterinarian.

The British Empire offers a unique field for advance in human knowledge in almost every direction in veterinary science. The whole Empire is proud of what has been done by South Africa in this field, and equally, if I may say so, by the ordinary British farmer scattered all over the world, particularly in improving all the breeds of domestic animals. And yet, in no field of endeavour are there greater gaps or greater need for scientific endeavour. Some of us do feel that until quite recently veterinary science has been working

too much in watertight compartments and has suffered from lack of recognition and assistance.

It may be that you will consider that some far-reaching recommendations from this Conference in regard to the advancement of veterinary studies throughout the Empire are called for, but as I am this morning limited to the subject of bureaux, I throw out for consideration the possibility of establishing somewhere in the Empire two bureaux, (1) for animal nutrition, and (2) for animal genetics. There is a vast mass of data already thrown out, but not always readily accessible and seldom interchanged.

In regard to the former the work of the Rowett Institute at Aberdeen is already Empire wide. The visits of Dr. Orr overseas and the research organized in conjunction with the Empire Marketing Board practically throughout the Empire and concentrated at Aberdeen is an example of what I have in mind. The lead given by Dr. Orr of that Institute seems to suggest that the field work on which he is engaged should not only be followed up throughout the Empire, but should be followed up in organized manner from the very start, and it is just possible that we may be able to organize a bureau for animal nutrition quite soon.

As to finance, I understand each new bureau would probably cost on an average £10,000 a year. The plant genetics bureau might cost a little more, the animal nutrition bureau might cost a little less. That, no doubt, would have to be made up by contributions on a similar basis to that already adopted in the case of the Bureau of Entomology.

I have, of course, been unable to go deeply into any one of the new proposals, but I hope this introduction will enable the Conference to find pegs upon which to hang what can be nothing else but one of its most important discussions.

Dr. G. A. K. Marshall (Imperial Bureau of Entomology): I feel some difficulty in speaking on this matter on account of the division that has been made as between the subjects of discussion this morning and this afternoon. It seems almost impossible to discuss adequately the question of bureaux unless there is included in that discussion the subject of the dissemination of information, which must be one of the most important functions of bureaux.

Chairman: As a point of order may arise hereafter on this, I think we are all agreed with what Dr. Marshall has just said, and I venture to say that so long as we do not get too far afield from the main subject it would be well to discuss both subjects. You cannot possibly divide the question of a clearing house of information from the subject of the dissemination of information.

Dr. Marshall: In his very instructive address Mr. Ormsby-Gore gave a general account of what our Bureau has been doing, but he inadvertently omitted one of its most important functions, and that is the identification of insects. The need for assistance of

this kind is strongly felt by field entomologists, for until the names of the species are known it is impossible to get access to the knowledge regarding injurious insects and parasites that is contained in the literature. As an indication of the extent to which this service is utilized, it may be mentioned that from 50,000 to 60,000 insects are received annually by the Bureau from entomologists in all parts of the world.

I entirely agree with what Mr. Ormsby-Gore has said as to the desirability of establishing bureaux only in subjects that are more or less compact, and which have also a large number of workers in the field. It seems to me inadvisable to start a bureau for such a subject as Agricultural Bio-chemistry, when perhaps there are only a dozen such bio-chemists in the Empire, and, in considering what bureaux should be started that is a most important point, otherwise we may find that we have erected a machine that will cost more than its output is worth. There is also a possible danger of over-organization in a matter of this kind. I believe the best way of building up this sort of institution is to start on a small scale and gradually to adapt the organization to the needs of the subjects as they arise, rather than to try to build up some big scheme that will cover the whole field of agriculture, thereby erecting our superstructure before we have laid the foundations.

It would thus seem that the wisest course would be to begin by establishing a few comparatively small bureaux for those subjects that show a real need for them. Each bureau should be placed under the control of a man who has a wide knowledge of the subject itself, who is interested in the problems that have to be solved, and who is in personal touch with the men in the field. I think I may say that I know personally at least 75 per cent. of the official entomologists in the Empire, and whenever Government entomologists visit this country they come to see us, so that we get into personal touch with them and learn what they are doing and what their difficulties are. This I consider a most important matter for the efficient working of a bureau. If we start by erecting an elaborate machine, that personal touch will be apt to go; the machine will crush it out; and that is a point we ought to bear in mind in making recommendations.

The abstracting of current literature, which is a very important function, will obviously be undertaken by each bureau for its particular subject, but this will still leave over a certain amount of literature, which will not be dealt with, and the question as to whether it is really desirable to form yet another organization merely for the purpose of abstracting this literature seems to be one which will require very careful consideration. I think that perhaps many of the difficulties that have been cited as regards the inaccessibility of certain published or unpublished scientific information can be met in another way.

I regret to say that I am not altogether in accord with my friend

Dr. Butler with regard to the reports of Directors of Agriculture. It is true that these reports are not published promptly enough and are not adequately disseminated, so that workers in other countries may get early information as to what work has been done. But I do not think it is desirable that the accounts of scientific work should be enlarged in such reports; I should prefer to see them even further reduced. What is the object of a Director's report? It is to let his Government and the public of his Colony know briefly what his Department has been doing. Such reports must necessarily have only an ephemeral value, and to include in them the first announcement of important scientific work is altogether wrong in my view. Such information should be rigidly excluded, and reserved for communication to some suitable journal dealing with a subject of that kind. At present we have a number of agricultural journals scattered throughout the Empire, which cover all sorts of subjects in connection with agriculture, and which serve a very useful purpose so far as local agriculturists are concerned. But from the point of view of scientific workers, I think we should benefit by the establishment of some more specialized journals to which Governments could send the work of their specialist staffs for publication. There will thus be built up a certain number of journals which will become the leading media for publication in their particular subjects, and they will tend to attract contributions from foreign writers also. Scientific workers and institutions in other parts of the world will necessarily have to obtain copies of these journals, and the sales will eventually contribute materially towards the cost of production. As compared with the method of publishing scientific matter in separate reports and pamphlets, the system of central journals presents several obvious advantages, in that the dissemination of information to those who are likely to want it will be much more thoroughly and more promptly effected in all countries; the possible overlooking of isolated reports will be eliminated; the information will be rendered more permanently accessible for future workers because the journals will be filed in numerous libraries and other institutions to which small local publications do not now find their way. Finally, for local distribution the Government need only order the requisite number of reprints from the central journal, which will cost much less than local publication. I cannot help feeling that this system will facilitate the objects we have in view and actually be a saving to the Colonies that make use of it, and, I think, that it will probably be one of the few suggestions emanating from this Conference that will actually lead to a decrease rather than to an increase in expenditure.

May I point out that in a report from South Africa there is a reference to this matter which seems to me to be very significant? It is :—

"The scientific publications of the Department are not

> issued for direct use to the farmers; indeed few, if any, ever see them. Their purpose is rather to record the results of research for the benefit of scientists in South Africa and beyond its borders. Comparatively few copies are required in South Africa; the large bulk goes overseas."

I think that entirely justifies what I have said that the method of distributing information is really inadequate. We do not want a number of small separate publications. They are the very things which are most difficult for abstracting bureaux to trace; they are very liable to be overlooked; and their appearance is erratic. If all that information went to a central journal, these difficulties would be done away with. At all events, that would be a useful contribution towards a more organized system of distribution of information, and that is actually suggested in the South African memorandum. They say further:—

> "The question arises, therefore, whether, in view of the international character of most scientific papers, there is not room for inter-state co-operation in the publication thereof, particularly as such publication is the essential corollary to scientific research."

We ought to think out some method of allocating the publication of these separate pamphlets so that we can eventually secure a number of sectional journals dealing with special aspects of agricultural research, which will immensely facilitate reference for research workers. I suggest that each bureau should have a journal of this kind, but the question as to whether any other similar journals should be issued is a matter for careful consideration. Naturally the editorial work should be done by a competent scientific man and not be put merely into the hands of a sort of publicity bureau such as has been suggested by the Indian Government.

With regard to the abstracting work of the new bureaux, it has been suggested that it should be restricted to work done in the Empire, but personally I think that would be a very great mistake. The work done in other countries must be taken into consideration, otherwise we should lose an immense amount of valuable information. It would be better to start on a few of the most important sections of agricultural science and do the thing properly, rather than try to cover all agriculture and restrict the abstracts to one part of the world only.

Dr. E. J. Butler (Imperial Bureau of Mycology): Dr. Marshall has left me very little to say on the subject of the organization of the Bureau of Mycology. I was in a very fortunate position in having the guidance of his bureau before me when I took charge, and my task was a very easy one, assisted as it was at every turn by the generous help which I got from him. I owe him a great debt in that respect.

I would like to emphasize a point which he made, that the Bureau of Mycology, like the Bureau of Entomology, had its origin, mainly, so far as overseas workers were concerned, in a desire to have prompt, and, if I may say so, reliable assistance in the identification of the organisms causing plant diseases. I was myself, for many years, in the position of having to go for help in these matters to countries which, as I reported to the Government of India in 1914, had then become to some extent enemy countries, and I pointed out that in order to get, as a right and not as a courtesy, aid in identifying specimens by which our difficulties in dealing with these organisms might be solved, we might see if we could not develop something on the lines of Dr. Marshall's bureau. I believe a similar action was taken in other Dominions quite independently of the move that came at the same time from home, but it was based in all such cases mainly on the necessity of getting some organization through which we could have our specimens and other inquiries promptly dealt with, not as a courtesy but as a right.

The other side of the work, the dissemination of information, is equally important, and these two branches of the work of the Bureau of Mycology are to a great extent run independently. So far as I have been able to judge from my short experience, the Bureau could not do its work properly if it had not specimens continually coming in for study. In other words in considering the formation of other bureaux on the lines of the Bureau of Mycology one of the first criteria I would make use of is, is it possible to send to those bureaux some material on which a report may be made or work carried out ? That, I think you will find, will be met in the case of the proposed soils and animal diseases bureaux, but would tend to rule out certain of those that have been suggested. The efficiency of a bureau depends on the soundness of the advice that it can give, so that not only the director of the bureau, but also his staff have continually to be working on their material ; they must know at first hand the organisms or substances with which they have to deal, and it seems to me it would be almost impossible to have a bureau working on the lines on which our bureau works—I don't wish to say anything about some other kind of organization which would deal with the subject in a purely advisory way—without its staff having first hand and continuously kept-up knowledge of the actual materials on which they were reporting.

I have very little to say in regard to the other functions of the bureau. They largely arise out of these two main lines. A very large part of the time of the scientific staff is given to the cultural study of certain groups of organisms which have led to great confusion in different parts of the Empire. The same organism has been given different names in different places and people have not been aware that the same disease occurs in many parts of the Empire. We have had case after case of that, and working out the identity of these various organisms by cultural study is a laborious task which

takes up a large amount of time. I regard that as work of primary importance, however, although it is work which does not appear to amount to much to the bulk of the men in the Department other than the mycologist himself. It is really very time-absorbing work, and I am sure that my colleagues will confirm me when I say that it is of the first importance that such work should be done.

Other minor activities include advice in obtaining supplies of material, information with regard to legislative methods in force in different colonies, and the duty of keeping in touch with outbreaks of dangerous diseases in different parts of the world, and reporting to the Dominions or Colonies concerned.

In regard to disseminating information by means of annual reports and separate publications I agree with a great deal of what Dr. Marshall has said. I should not in any way expect to find a completed account of work of fundamental scientific importance included in annual reports. I think Dr. Shaw would bear me out that our annual reports in India were restricted by the Government to something like eight or ten pages for each section. That is not a large amount in any one year, but in that space one was able to give a cursory account of the work actually in hand. That work was often not published in the form which Dr. Marshall prefers until some two or three years later, but at the same time it was of very great use to our colleagues in other parts of the world to know what we were doing, and they got that information as a rule 6 months or a year after the investigation was undertaken. In that way, in a limited way only, I would like to see a system of annual reports framed with a view to securing that each scientific officer in a department was responsible for giving just a very short account of new work which he had undertaken, but without publication of a complete description.

Sir Arnold Theiler (South Africa) : I have listened with great interest to the discussion of the proposed bureaux. On this matter I speak as a veterinarian who sees no difficulty in establishing a Veterinary Bureau, particularly a bureau to deal with tropical and sub-tropical problems of animal health. Let me make it quite clear what I understand by a bureau. Names do not matter, it is the idea which counts, and provided some kind of organization is set up we can find an appropriate name for it afterwards.

To my mind there is no doubt that we need some sort of central organization, call it bureau, or clearing house, or liaison office or whatever else you please, which will help to establish contact between scattered workers on problems of animal disease, and to co-ordinate their efforts. What has been said by Dr. Marshall and Dr. Butler applies, *mutatis mutandis*, to veterinary science, but we have to bear in mind that in our province it is not a single scientific subject we have to deal with, but a defined group of problems. Since our function is to prevent the spread of animal disease we must place the animal in the foreground, always keep thinking in terms of the

animal, and design our organization to bring all the sciences relevant to our problems into focus on our particular interest. The very fact that our subject matter is so diverse makes it all the more necessary that a central organization should be established. To my mind a " Bureau of Epizootic Diseases " is even more necessary than the existing Bureaux of Mycology and Entomology. We would of course have to work in closest touch with all other bureaux of applied science, utilize their services where possible, and refer to them many aspects of our central problem.

At first sight it might seem that our task is so vast that it is beyond the handling of a small central organization, but closer examination shows that this is not so. We must remember that our main function is state veterinary hygiene and research into preventive measures for eradication of animal disease, particularly in the tropics and sub-tropics. We can practically ignore what I might call the " practitioner " aspect of veterinary science, and concentrate upon animals in the mass. Throughout the greater part of the Empire the significance of the life of the individual animal is small in comparison with that of the herd, and it is chiefly the devastating sweep of transmissible disease which we must guard against. It is preventive and not curative measures which we must stress and our bureau must always keep the functions of state control in view. We must not forget that the health of livestock is not a matter of sentiment, but of economics, and that this fact simplifies our task enormously as compared with the task of the medical profession.

One of the first duties of a " Bureau of Animal Diseases " would be to correlate existing data, make a survey of the problems as they exist throughout the Empire, and find out how, and above all where these problems can be most profitably solved. I do not suggest that the bureau would attempt to allocate or supervise work in various parts of the Empire, but it could bring scattered workers into contact, assist with advice and literature, and so perhaps induce concentration upon certain common problems in the area most suitable for their solution. The central organization should be a place to which detached outside workers could go for help, which could bring them into contact with specialists in individual sciences cognate to their problems, and arrange when necessary for identification work to be done in other institutions better equipped for the purpose. I see, for instance, admirable opportunity for linking up the services of existing bureaux such as those of Entomology and Mycology, and of institutions such as the Rowett Institute, Rothamsted, Onderstepoort, Weybridge, to mention only a few, with the clearing house work of the type of Veterinary Bureau I have in mind.

A great point has been made of the necessity for personal contact between workers. I feel very strongly on that. The better people know one another the easier it is for them to co-operate in subsequent

work. The personal element in intercourse, derived both by contact and correspondence, is so important that I would suggest it as part of the work of the bureau to arrange that men attached to the central organization and British institutions would go out and visit men working in different parts of the Empire. Sometimes when a man is isolated he loses courage and interest in his work, but if he receives a visit from someone from a central organization it would cheer him up and he would have an opportunity of discussing and surmounting difficulties which faced him. He would feel that he was not ploughing a lone furrow, but that he was a member of a team of earnest scientific workers. I need hardly add that it would do the visitor just as much good as the visited. It would enable him to realize at first hand the difficulties his distant colleague had to contend with, and it would give him a clear picture of the nature of the problem in other parts of the Empire.

I also think the central organization should issue a journal, and on this matter I quite agree with what Dr. Marshall has said in regard to the functions of publication. Research publications should be separated from popular communications. Each country of course, publishes the practical results of its scientific veterinary research in popular form for local consumption by the farmer, but we do want a central medium for highly technical scientific papers, for occasional scientific reviews, and for selected scientific abstracts. At the present time we have, it is true, a Veterinary Bulletin which provides abstracts, and so far as it goes, it is useful. But it is not enough. We want something much more, something which publishes research papers, and which provides distant original workers with material they cannot easily obtain in any other way. I would even suggest that translations of important researches published in foreign languages should appear in such a journal either in full or in summarized form. I would also suggest that information collected through other Imperial channels should be presented through the journal. I know, for instance, that the Colonial Office has collected valuable information in the last 50 years, but all this is stored away in pigeon holes as documents which are never read. That is not only true of the Colonial Office, but of other bodies, and it should be one of the tasks of the central organization to sift all that material so that what has been learned in the past can be used in the future, and as fast as new information comes in through indirect avenues it should be systematized for the journal. Some of you may imagine that the journal I have in mind would be a voluminous and expensive thing, but this need not be the case if it is properly organized. I would not propose to include research papers in special sciences cognate to our main problems, but rather to get them taken over by the existing journals dealing with the sciences concerned, and only indicate by abstracts where they were to be found. I would like to see the journal of the bureau confined to papers dealing with eradication of animal diseases, and stress

the epizootic diseases of tropical and sub-tropical importance. The volume of such research publications to-day is not great, and could well be brought within the compass of one journal.

To refer now to the administrative side of veterinary work, we should all have an interest in noting what is going on all over the Empire, and a useful task of the Bureau would be the codification of all legislation relating to the control of animal diseases. At present men in one part of the Empire often have no clear idea of the detailed operation of legislation in other parts, and a clear statement of laws, regulations, machinery of administration, and reasons for local variation of method, throughout the world would be of great value in helping the men whose task it is to administer laws designed for preventing or stamping out animal diseases in particular areas.

I might enlarge further upon the useful functions of a veterinary bureau, but I think I have already made out a sufficiently good case for the establishment of some sort of a central organization. I think that this central organization should be in London, where we should be able to keep in touch with other bureaux and, through exchange of ideas, keep our organization as flexible as possible. Above all I would like to see the workers dealing with problems of preventable animal disease brought into closer contact with the workers on preventive human medicine. Thinking in terms of disease, man, after all, is only one animal, and the problems of the research workers on human disease and on animal disease should be common ground. The medical investigator and the veterinary investigator are both workers in the field of applied biology, and should be brothers in arms. In the tropics and sub-tropics particularly, the problems so overlap that co-operative work is absolutely essential—I only need mention the Trypanosomiases. Any bureau for animal diseases which may be created should endeavour to maintain the closest contact with existing organizations for investigation of human diseases. The type of bureau I have suggested could do much to increase the prestige of veterinary science throughout the Empire and bring credit to British biology throughout the whole world.

Dr. C. J. Reakes (New Zealand): We in New Zealand are particularly keen on having made available facilities for securing exact and reliable information of what is being done by scientific workers in other countries. We are, so to speak, at the ultimate end of the earth, isolated from the more thickly populated countries where scientific work is carried on in very much greater volume, and we are, therefore, largely dependent on the information which we get in the form of literature for being able to keep abreast of the knowledge that is being acquired elsewhere year by year. We have appreciated greatly the value of the Bureaux of Entomology and Mycology; they have been of great help to us, and that fact in itself emphasizes in one's mind the desirability of establishing

bureaux to deal with other main subjects of scientific activity. I do not propose to go into details now as to the exact functions of any particular bureau; that, I think, can perhaps be dealt with better when we come to discuss the subject in Committee, but I do realize that it would be of great value to all scientific workers to have bureaux established upon which they could depend for obtaining regular and reliable information.

One of the matters which impresses itself very strongly upon us is the necessity for obtaining further knowledge, and for carrying out a very great deal of research, in connection with certain animal diseases. New Zealand is dependent upon the money she receives from the export of primary products derived from domesticated animals. Dairy produce, frozen meat and wool constitute by far the greater proportion of her exports. Consequently the question of animal disease is one which impresses itself very strongly upon us. We have in our Veterinary Branch some capable men, who, I think one can say without presumption, are doing very good work, but I have personally been impressed by the great difficulty experienced in absorbing the knowledge which is made available, or which should be available, of current work in other parts of the world. It involves, amongst other things, a large amount of reading, occupying time which the research worker, if he had better facilities for obtaining information, could devote to his actual research work; and a research worker cannot devote too much time to that.

Therefore I am cordially in support of the view that a Bureau of Veterinary Science or Animal Diseases, or whatever we like to call it, should be established, and should be established in Great Britain. Further, the suggestion was made, I understand, that any Bureau established should be limited to dealing with work within the Empire. That, I think, would be a very great mistake. We want to get all the knowledge we can, no matter where it comes from.

The suggestion of a Bureau of Soil Science is equally good. That would be of much value to us in New Zealand, where we are doing a great deal of work in connection with soils and where we are desirous of doing a great deal more. As in the case of veterinary work, we want our men to be able to obtain the information they desire in as concrete a form as possible, and further to be able, through the medium of a bureau, to get into touch with their fellow workers in other parts of the Empire and of the world. The suggestion was made that Rothamsted would be a good site for a Bureau of Soil Science, and I think that is an excellent idea.

The question of animal nutrition, again, is one of very great importance to us. We have very greatly appreciated the work which is being done, particularly at the Rowett Institute, and it has been of very great advantage to us to have been able to be in personal touch with Dr. Orr and his fellow workers there. The establishment of a special bureau would enable us to secure some-

thing approaching an equally close touch with workers in other parts of the Empire and elsewhere.

Therefore, I feel that I can cordially support the general principle of bureaux, and I desire to stress the necessity for establishing a Bureau of Veterinary Science or Animal Disease.

The question of cost has arisen. I might mention that as regard the Bureaux of Entomology and Mycology, our Government already makes an annual contribution towards the cost, though perhaps a small one, and I believe that a sympathetic view would be taken in regard to assistance in connection with other bureaux which may be established.

Sir Rowland Biffen (Cambridge Plant Breeding Institute) : I had hoped that this subject would have been treated by some of our isolated workers rather than by myself, for I feel that my experience may be rather misleading to other workers. I have always been in the happy position of finding on my table all the periodicals that I require, and in many cases a good many more. Hence I have a very real difficulty in putting myself in the position of a man living where he receives no literature at all. Plant breeding is a comparatively new subject and it is fortunate in this respect that its literature is fairly self-contained. We have half a dozen periodicals in which we can without the slightest difficulty find all the scientific information which we want. Now, when we come to the applied side of the subject we meet with a different state of affairs. There is no great bulk of literature as there is on the scientific side and what there is is admittedly rather badly scattered in publications coming from the Dominions, Colonies and so on. But the actual bulk of applied literature is small, and I think that the whole tendency in the future will be for it to remain in that condition, for when all is said and done, applied plant breeding is very largely a matter of routine and the man who is solving its problems up and down the country very seldom has any need to write up his experience in detail. I can recall a case where I spent sixteen years on a problem and when it was over I put aside my pile of notebooks as of no use to anybody else ; they were full of records which no one else but myself has ever seen or wanted to see. On the whole I am a little doubtful whether there is any necessity for publications in plant breeding such as those which are being issued from the Bureaux of Mycology and Entomology.

In general practice there is, however, this great difficulty, and it is one in which probably the bureau could be of assistance, that is that it is extraordinarily difficult to get reliable technical information on the crops on which one is working. My own work has been confined chiefly to England, and in this country I have been able to get fairly satisfactorily the information required. I do not know how the isolated worker can obtain his information unless he can get into touch with manufacturers. How far the Imperial Institute could provide a worker with the precise type of information he

requires I do not know, but it is, I think, a piece of work which might possibly be undertaken by a Bureau of Plant Breeding, if such an institution came into existence.

Now, turning again to the literature of the subject, I have indicated that it is small at present. Further than that it is being on the whole fairly well abstracted. But at the back of my mind there is a doubt whether these abstracts are really as useful as they are considered to be, for my general experience is that an abstract does not carry one far and the most it does is to give an indication of where one can find the papers. I seriously suggest that instead of our isolated workers trusting to what I may call a catalogue of abstracts their Governments should put up the £15 or £20 a year which would be necessary to buy the whole bulk of the literature and provide their workers with it. It seems a better policy than creating an organization to provide these comparatively useless abstracts. Beyond that I have nothing to say except that I shall be extremely interested to hear the views of my colleagues who are working overseas.

Mr. A. Holm (Kenya) : On behalf of Kenya I should like wholeheartedly to support the proposals in regard to an extension of bureaux connected with agricultural science. I believe very strongly that these bureaux will become no less than the keystones of any scheme designed to further co-operation and assist agricultural research throughout the Empire. It is essential that the greatest possible use should be made of existing organizations for this purpose. It may be that the heads of these existing organizations may consider the financial aspect of the matter, and if they are called upon to act as clearing houses of information necessarily additional staff and resources will have to be provided in these organizations. I should like to offer a suggestion that the Secretary of State may through the proposed new Agricultural Advisory Council and out of the funds which may be placed at its disposal subsidize the existing organizations to enable them to carry an additional complement of staff for the purpose. In my view the bureaux should constitute the homes of research workers during periods of leave and again when they may find it necessary to complete a piece of research work that they have started overseas but have been unable to complete because of shortness of staff or lack of resources. I regard this big movement in connection with the organization of Imperial Agricultural Research as of the greatest importance. Let us build on these sure foundations of bureaux step by step. I feel that these bureaux will feed with scientific knowledge and information not only the staffs of the central research institutes of which we were talking yesterday, but agricultural research workers serving in different Departments of Agriculture in the different Colonies and Dependencies.

Dr. A. W. Hill (Kew) : As Mr. Ormsby-Gore has said, Kew does act in a very similar manner to the Bureaux of Mycology and

Entomology with regard to matters of economic and systematic botany. Nowadays some of the economic questions have to be referred to Sir William Furse at the Imperial Institute and historically his Department is an outgrowth of the economic botany side of Kew, since the study of economic botany was first systematically taken up there in the old days. I think these bureaux serve an extraordinarily useful purpose, and one particularly useful purpose they serve is that the heads of the bureaux, as I find in my own case, regarding Kew as a bureau for the moment, are enabled to get into personal touch with the workers in the different Departments overseas. It is very essential that in association with the bureaux, as has been made possible for us at Kew, there should be an officer or officers who are able to travel about the Empire and get into personal contact with the workers and their problems on the spot. The Empire Marketing Board has made it possible for us to have that privilege, and my Economic Botanist has just returned from the West Indies and British Guiana, and I am to have the privilege of going to Australia, New Zealand, Singapore and Ceylon. I am sure that such opportunities of personal contact and of studying the problems confronting our colleagues overseas in their own spheres are of the greatest importance.

Then there is the question of the independence of the bureaux, which is another important matter, especially in view of a proposal or a suggestion which has been made in memorandum No. 4, page 6. The quasi-independence of these bureaux, including Kew, is a most important factor because it enables us to keep in close personal touch with the workers. If my material and the correspondence I deal with were sent to my Ministry and they sent on to me the things they thought I could profitably deal with I should not be in as happy a position in regard to my work generally as I am at present, and I believe Dr. Butler and Dr. Marshall would say the same thing. Therefore, I consider that the idea of setting up some super authority as a central clearing house for the more specialist type of investigation is not the best way of dealing with the problem. Some central clearing house may be the right way of dealing with general agricultural questions, and miscellaneous unspecialized enquiries, but I think for special lines of work it is far better to work on the lines of the bureaux as they exist at present. It is true our two bureaux are looked after by a managing body with a layman acting as Chairman in the person of Lord Buxton, but these governing bodies or managing committees in no way fetter the work of the Directors. A recent article in the *Times* on the new Royal Commission on Museums pointed out that the Director of Kew was more or less an autocrat. In some ways it is not a bad position

In regard to general agricultural matters I do think there is a considerable need of some organization for dealing with the information which is contained, or not contained, in agricultural reports.

One knows perfectly well that in our Dominions and Colonies a great deal of work is being done which, as Dr. Marshall pointed out, only appears in rather a meagre form in agricultural reports. We want to know very much more of the actual work which is going on. Sometimes it may be work which is not considered worthy of putting in a general scientific paper, but is very useful work all the same, and it would be very useful if the results or the accounts of such work could be sent, not necessarily for printing in a report, to a central clearing house in London, possibly connected with the Imperial Institute, where such reports and accounts could be digested and the important parts brought to the notice of workers engaged in similar work in some other part of the Empire. That applies not only to literature produced in our own Dominions, but to the very important work carried out in foreign countries where they are studying problems very closely akin to our own.

I might mention in conclusion that there is, as I think you are aware, a proposal on the Continent for the establishment of a sort of bureau or clearing house of information relating to Tropical and Sub-Tropical Agriculture. This was considered last year at Paris, and the Association Internationale d'Agriculture Tropicale is to meet in Rome next month, the idea being to try and set up a kind of clearing house in connection with the Rome Institute. It does not appear that the Rome Institute will be able to be of as much use to Tropical Agriculture in the British Empire as is desired, but I think the Conference should be aware that there is a movement of the kind taking place and that something may be set up in the way of an international body to deal with Tropical Agriculture in connection with the Rome Institute.

Colonel G. K. Walker (Punjab): As a veterinary delegate from India I can associate myself very whole-heartedly with what Sir Arnold Theiler has said, both in his memorandum and in his speech, in regard to the great desirability of forming a Bureau for Animal Diseases. In India we have, as you know probably, an organization for dealing with and a central institute for the study of animal diseases, but information in regard to their activities is disseminated from India at present in a way which, personally, I do not think is quite satisfactory. We shall be enabled by the formation of a bureau to be in closer touch, and I believe there will be a great development in veterinary research in India as a result of the recommendations of the Royal Commission on Agriculture now sitting. There is sufficient scope, as you all know. The problems in India are similar to those in the rest of the world, and we shall be enabled to progress with other workers and they with us if such a formation is brought about. There is not likely to be a dissenting voice in regard to this question. The title and other details of this proposed bureau will probably be settled very satisfactorily in discussion later on by the Commission. One point that I think I

might bring out in regard to the advantages to be derived from separate bureaux is this. We have a Bureau of Entomology, there is also a Bureau of Tropical Diseases, and this particular bureau, the proposed Veterinary Bureau, should be in very close contact with them. Its formation would enable that to be done in a more satisfactory way than has hitherto been possible. I am quite sure that the Bureau of Tropical Diseases wishes to be associated closely with the Bureau of Entomology and with the proposed Bureau of Animal Diseases. I trust that this proposed bureau will be brought into being as soon as possible.

Sir Robert Greig (Board of Agriculture for Scotland): The suggestion of my Board reproduced near the end of Memorandum 3 really arises from the fact that we have had in recent years considerable experience of the diversity and complexity of the soils in Scotland, which we have been trying to farm for the last thousand years or so. For some years past we have been attempting to do some soil survey work, and I need hardly say in a modest and thrifty fashion. We have been able to induce the Rockefeller Foundation in America to pay the salary and expenses of one of their most eminent soil surveyors to come to Scotland and give us the benefit of his experience and of the American methods. Arising out of this experience we have ascertained how valuable it is for us to know what kind of soil types and soil profiles we are dealing with. In close association with the University of Edinburgh, the Geological Department of the University of Edinburgh and the Geological Survey we are attempting to set up a collection of soil types and profiles for our own information. It has, therefore, occurred to us that if a Soil Bureau is set up in this country or in any country in the Empire it would be of the greatest value to include in that bureau a museum of soils which could be used for comparison and reference. As an illustration of what can be done, I read in an American journal (and coming from America it must be true) that a certain valley in Massachusetts contained a soil precisely similar in texture, profile and chemical analysis to a soil in a Southern State on which tobacco of a certain quality was grown successfully. The difference in the two localities was one of rainfall, and this difficulty was overcome by spreading cheese cloths over the crop in Massachusetts thereby producing the humidity and temperature equivalent to that in the Southern State, with the result that the tobacco grown in the Massachusetts State was almost as good as that grown in the Southern State with great advantage to the owners of land in that district and to industry. I offer that as an illustration, an American illustration, of what conceivably might be done if we had a museum which contained a selection of soils which could be compared and referred to. Now, I take for granted that this Conference will on the whole approve of a Bureau of Soils set up in some part of the Empire for the purpose of collecting and disseminating information, and I suggest when we come down to

the point of making recommendations and resolutions that this aspect of the subject should be carefully considered by the Conference, and if a Bureau of Soils is set up a collection or Museum of Soils may be added to it. I would also suggest it might be the function of this bureau to attempt to devise uniform methods of soil analysis and uniform methods of nomenclature. I was interested in what Dr. Marshall said in regard to the classification of insects in his Bureau. Surely it would be a reasonable proposition to assume that a Bureau of Soils would contain experts who would be capable of giving advice upon the types of soils which were sent in to them from different parts of the Empire.

Dr. P. J. du Toit (South Africa) : My remarks will concern the proposed Veterinary Bureau. Two views have been expressed here this morning, one put forward by Mr. Ormsby-Gore, namely, that the subject of veterinary science is far too wide to be embraced in the work of one bureau. With that view I find myself in agreement. We could no more have a Bureau of Veterinary Science, as such, than we could have a Bureau of Medicine, as such, yet we must bear in mind that in medicine they have a most excellent and an extraordinarily useful Bureau of Tropical Medicine and Hygiene. That bureau—I am speaking subject to correction—started nearly twenty years ago as a Sleeping Sickness Commission. It gradually grew out of that Commission, and I think this parallel might be of use to us. If we start a bureau dealing with one aspect of veterinary science we may be very modest at first and rather build up from that modest beginning in preference to starting a superstructure now, and then find afterwards that it will collapse for want of a solid foundation. The suggestion I wish to make which perhaps will cut short some of the discussion, both here and in the Commission, is that the subject be referred to the Veterinary Committee to thrash out some plan and that that plan then be submitted to the Commission on administrative matters and that that Commission should report back to the Conference.

Sir William Furse (Imperial Institute) : I have just returned from a most interesting tour throughout Canada in connection with the other side of our work at the Imperial Institute, namely, the mineral side, which does not connect up directly with this Conference, but allusion has already been made by more than one speaker to the importance, where you are setting up these bureaux or clearing houses of information, of the Director getting into personal touch with the actual workers throughout the Empire, especially those overseas. In my case I was only appointed to my present position one and a half years ago, and I have done my best to induce workers from overseas to come and get into personal contact with me and my staff when they return to England either on business or pleasure, and I am glad to say that that is being achieved. The visit to Canada enabled me to get into personal touch with a large

number of gentlemen, officials and otherwise, and put me immediately into a better position for dealing in the future with the questions that arise at the Imperial Institute in connection with Canada.

At the Conference held by Mr. Amery of Colonial Governors last May I was given authority to address myself when necessary directly to Directors of Agriculture in any colony overseas. Direct touch by correspondence instead of using the official channels also facilitates the work of any bureau or clearing house of information. From that lead given me by Mr. Amery, I realize people in my position are trusted to know the limits within which they may act under that sort of permission.

Mr. Ormsby-Gore, in opening this discussion this morning, very wisely suggested that we should begin slowly and build up, and I think Dr. Marshall informed us that he was entirely in favour of that practice, and he had found that it worked well with his own bureau and he hoped that would be done in any new bureau which was set up. Dr. Hill has already mentioned that the Imperial Institute may be looked upon as the clearing house of information and the investigators of samples from an economic point of view, and that, I think, puts it as clearly as possible.

I asked at one of the meetings of Colonial Governors in May that our functions, as the clearing house of information, should, if possible, be rather more closely defined. At present we work on these lines, that where a distinct bureau exists already, as in the case of entomology, mycology and botany, we do not do anything but send queries on to those particular Directors, and we do not disseminate information such as they disseminate in their bulletins. On the other hand we do our best with that vast range of subjects in which no bureau at present has been set up, and I am going to make this appeal to members at this Conference, that, realizing that, they should send us from time to time such up-to-date information as possible concerning the work they are doing on these general subjects in order that we may go through that information and spread it out once more to all the outlying parts of the Empire through the medium of our bulletin. I believe that if increased attention was paid to that throughout the Empire it would have the great advantage that it would enable us to inform the Colonial Office and other people concerned that, judging from the mass of information that was coming in and the queries that we received, the need of a new bureau to deal with a particular subject would appear to be worthy of closer consideration.

Major G. N. Blackshaw (Southern Rhodesia) : On the question of whether a system of bureaux, as now exemplified by the Bureaux of Entomology and Mycology, be extended to other departments of agricultural science, I am instructed by the Southern Rhodesian Government to say that they consider such extension to be desirable. I did not have an opportunity yesterday afternoon of referring to

the more important agricultural problems peculiar to Southern Rhodesia which call for attention, but I may say that, apart from the study of the question of African coast fever, the problems which call for continuous and co-ordinated research in Southern Rhodesia embrace such things as animal nutrition and, of course, in common with other parts of the Empire, questions of improvement of soil fertility. There can be no doubt whatever that if some central organization is set up which embraces within its sphere questions such as those I have mentioned, reference thereto by workers in the Colonies for assistance and for guidance in the laying out of a proper foundation of work which they propose to carry out cannot be but helpful to the prosecution of the research.

Sir John Russell (Rothamsted Experimental Station): The proposed Soil Bureau should, in my view, deal with all matters relating to soil as they affect the agriculturist, including soil mapping and soil survey, soil management, soil improvement and deterioration, and those very important subjects erosion and irrigation. Further, it is impossible to separate soils from manuring, and that, of course, necessarily includes plant nutrition. It has been suggested by my friend Mr. Holm of Kenya that the bureau might deal with plant nutrition. I am sure he has in mind not the purely physiological side which, as Mr. Ormsby-Gore has pointed out, would not come within the scope of a bureau, but the applied practical side: this would quite naturally come within the purview of a Bureau of Soils.

The purpose of a Bureau of Soils, if set up, would be, first of all to collect and disseminate information both on the technical and on the more purely scientific sides. Soil science is in a very fluid condition; our conceptions have changed a good deal within the last few years, and they are still changing. It is very desirable that soil workers everywhere should have information about the new developments in pure science which have a distinct bearing on soil work.

Secondly, the bureau would maintain a library and a museum of soil types. In this library men at home could finish their reports. It might be possible for the library to lend out to workers in the field certain books or journals which they could not get themselves: in any case it could send photostatic prints of papers, or the essential parts of papers to such workers. Any soil worker in the Empire could send to the bureau and ask for tables or other papers.

Then I consider that the bureau should maintain a laboratory where men who are home on leave can finish off some of their investigations. I have been struck in the last few years with the important work on soils that is being done in some of our overseas Departments, not only in the big ones where you expect such work, but even in the small ones. To mention those who are not with us to-day, I have in mind such work as that done by Mr. Martin of Sierra Leone and Mr. Hardy in the West Indies; work which is not only of importance in those countries, but has a great bearing

on the important scientific problems of soils. It is hardly to be expected that Departments could always put up for those men the costly apparatus which is required to do the work. Not very long ago Lord Balfour said, with some degree of truth, that modern science was almost as expensive as war. It is not practicable for all agricultural laboratories in the Empire to be fully equipped with the necessary appliances for soil work, but the home laboratory, the laboratory of this bureau, could and should have all this equipment so that men could go there to finish off their work ; not leave it in the approximate stage, but get it into the final stage for publication. Further, at this laboratory men who are home on leave could familiarize themselves wtih new methods, and new conceptions in soil science. We know from our own experience how such opportunities are appreciated ; during the summer time we have in our laboratory men on leave from the overseas parts of the Empire coming to familiarize themselves with recent developments.

Then it would also be necessary for the staff of the Bureau to examine the many methods that can be used in attacking soil problems, and recognizing that methods in the field must be rapid, simple and suited to native assistants, pick out those most suitable. As far as possible the Bureau should try to secure uniformity, but that cannot always be done. Then the bureau could make a comparison between the methods used in one place and another, so that the workers should know, at any rate, where they stand. Also these approximate methods would have to be compared with the more exact and refined methods that could be tested in the laboratory. Those are the chief purposes which a Soil Bureau could fulfil.

Obviously, of course, a Soil Bureau of that sort would have to be very closely associated with the research workers in soil science. You cannot separate the Bureau from the research. Once you do the bureau becomes static. Mr. Ormsby-Gore kindly suggested that we should be a very suitable centre. I am quite certain that my Committee would be very willing indeed to co-operate. It is their sole idea to be of use to this country and to the Empire. When it came down to sordid details we should, of course, have to consult with the Ministry of Agriculture. We are an independent Institution, and we value our independence very highly, but we have to remember that the Ministry is the good uncle that furnishes us with most of our income and we should have to consult with them. I can only repeat that we do want to help in every way we can, and we should only be too proud to think you had asked us to help in this way.

Chairman : There will not be time to hear all those we should like to hear before we adjourn this morning, but I am going to take it upon myself to suggest that, as the subject to be discussed this afternoon and opened by Mr. Julius, of Australia—interchange of information—is necessarily a closely allied subject, we should

continue this discussion this afternoon as though it were part of the same subject.

Dr. Stenhouse Williams (National Institute for Research in Dairying) : As many of you know, the Institute with which I am concerned was started comparatively recently and has grown very much in the fourteen years of its existence. We have found that if you are going to undertake dairying research efficiently it is necessary to study a very great variety of problems, such as the influence of foodstuffs on cost of production of milk ; consideration of the breeding of the cow for milk production and, after you have done that you have still to consider the question of the milk itself and the milk products that are made from that milk. In relation to all those you have also to take into account a certain number of diseases which may be carried by milk to man, so that your industries may be put into a good position. If you will think about it you will realize that, in order to do such work we have to make use of a very great number of different sources of information. There is no real literature which directly deals with our problem. The result is that we have to search over a very wide field indeed in order to make sure that we are not missing something that matters to us. That, of course, involves an enormous amount of labour. How great that labour is nobody can really conceive unless they try to do it. We have to try to do it, as far as our powers will allow us, and as far as we possibly can we communicate all the information we possess to those who are interested in similar work. We have found that to be of the greatest advantage to us in establishing relationships with our colleagues in many parts of the world, and we feel, as I think everybody must feel, how valuable it would be if by some means this scattered information could be gathered together and put into such a form that it would become more readily accessible to those who are engaged in dairy research.

6.—Interchange of Information.

Thursday, 6th October, 1927.

Mr. G. A. Julius (Australia) : There are two reasons perhaps why it is not inappropriate that I should introduce this subject. First, it is only on some such subject that I, as an engineer, may perhaps make some contribution to the work of this Conference, and secondly, on looking through the Conference memoranda on this question of the " interchange of information," I find Australia to be guilty of the only discordant note.

As with the brochures supplied in connection with the preceding discussions, the Memorandum* published by the Organizing Committee of the Conference on the " interchange of information " is full of " meat," and provides an admirable summary of the various recommendations that have been made on the subject. From this

* Appendix B, p. 228.

memorandum it is obvious that there is a very general realization of the need for efficient machinery to secure an effective and real interchange of information—a need so obvious that it is unnecessary for me to waste your time on that aspect of the question.

As an engineer, and one, therefore, engaged in the practice of a profession in which, from the very nature of the work, exact recording is essential, I appreciate fully the handicap that is imposed upon research workers where such records are unavailable. I recognize, also, that the recording and the interchanging of the results of research are likely to be very much more difficult when dealing with agricultural research.

Memorandum No. 4* issued on this subject, narrows down the scope of the present discussion to the question of the interchange of information through correspondence and publications, and it is, therefore, from that point of view only that I propose to review the matter. Obviously, if information is to be interchanged, there must be something to interchange, and this "something" can only be produced to the most useful extent by those research stations in which an exact system of research records is organized and maintained.

Further, in order that the interchange of records may be of maximum value, the system of recording in the various stations should be, as far as practicable, the same. Records, in my opinion, in connection with any particular item of research, should include clear statements regarding the object and the programme of the research. They should also contain a clear and concise précis of the work of other workers on the same subject, and, of course, finally a complete record of the work done, and of the deductions made by the investigator, or his chief, as a result of the research. All this, it seems to me, should be carried out as far as practicable on standardized lines.

Obviously the preparation of such a record of research must include a précis of past work on the subject—a précis which should, in my opinion, be made by the man engaged upon the research. Use, of course, may be made of indexes, summaries, &c., produced by some central organization, but it would appear to be necessary, in most cases, for the research worker himself to study as much of the literature and records of earlier work on the subject as may be possible. Further, it would appear to be equally necessary that the record of his own work should contain a précis of the studies that he has made of the work of other men, so that those who come after may clearly realize what data he had before him, and the state of knowledge on the subject at the time he carried out his investigation. Only thus, it seems to me, can his results be appreciated.

I recently paid visits to many British research stations, and at one I found a system of records which not only compelled my

* Appendix B, p. 228.

admiration, but also convinced me that if that station's opposite number in Australia could become possessed of a copy of these records, years of work could be saved, and the money available spent to maximum advantage, because the work already fully covered elsewhere could be pruned, and other work expanded.

It may interest you, perhaps, to have some details of this system of recording, which, through the courtesy of the Chief of the research station in question, I am able to give you. I do this because it seems to me it is of little use to discuss means for the interchange of information unless you consider the manner in which it is to be presented as it becomes available from the various research operations.

Before experimental work in connection with any new investigation is allowed to commence the suggested investigation is discussed by the Director of the Station and the workers who are to undertake the experiment. When the objective has been clearly defined and the method of attack outlined in some detail, the proposed scheme is set out so as to make clear the subject, the names of the workers, and the objects of the investigation. The method thus gives a definite, clear and concise statement of the information desired and full details of all the factors involved.

This provisional scheme is then discussed with the Heads of all the Departments in the Institute, and, if necessary, amended in the light of suggestions and criticisms made. When finally agreed upon, the investigation is authorized and is entered by the Recorder in the appropriate Record Book *before the actual work is begun.* As the investigation proceeds the data accumulated are entered at convenient intervals.

When the experiment is ended—either because it has broken down through the occurrence of unforeseen factors, as frequently happens, or because the work outlined has been completed—the data are summarized and graphed. All observations made during the work are noted. The results are reviewed sometimes during the course of the work, and in all cases at the conclusion. The records are closed with the entry of the conclusions reached, or suggested explanation of a breakdown, where that has occurred.

The same system is used in joint investigation with other institutions.

The advantages of this method are :—

(1) Clear thinking is promoted. Waste of time working on hazy, badly thought out schemes, is prevented.

(2) All the Heads of Departments have a knowledge of and interest in all the main lines of work of the Institute—hence, for every piece of work advantage is taken of all available information and experience.

(3) A complete record of all work, whether published or unpublished, is kept in a form easily accessible either for

workers at the Institute itself or for other workers at other institutions interested in the subject. Sometimes the preserved data and observations of experiments thought at the time to be failures have subsequently proved to be of great value.

(4) Continuity of work is made possible by some method like the above. Where such a system is absent, when a worker leaves or undertakes new work he carries with him much of the information and experience which he has acquired but has never recorded in permanent form. A new worker needs to begin at the beginning again, hence there is needless repetition.

Abstracting Literature.—Each set of abstracts deals not with divisions or sub-divisions of branches of science but with the main problem or set of problems actually being studied; therefore any one set of abstracts includes references to papers and journals dealing with a number of different branches of science.

Each senior worker abstracts the literature bearing on the problem which he is investigating, and makes a permanent record of the information abstracted. When the paper abstracted deals with experimental work, the abstract is made out in the following form :—

Title of Paper—Author—Journal—Vol. p., date.

(1) Object of work recorded in paper.

(2) Method used.

(3) Summary of results obtained.

(4) Conclusion reached by author.

(5) Criticisms by abstractor.

The abstracts are typed on loose leaves; they can, therefore, be arranged or re-arranged as required under various headings and sub-headings.

Frequently after investigation has proceeded for a certain time the worker stops experimental work and devotes himself entirely to abstracting, sometimes for a period as long as three months.

In some cases where the literature of a subject is very wide a worker with a general knowledge of the subject is taken on specially for the purpose of abstracting. This abstractor, however, always works in association with a senior worker who has actual knowledge of the problem on which information is being collected. These abstractors are, therefore, little better than clerical assistants to the research workers, though in that capacity they enable the work to be accelerated.

The essence of the scheme is that the information being collected has a direct bearing on problems being studied. It is the problem, not the scientific subject, which is the centre of vision. Hence,

the information accumulated is of interest to a number of workers, who assimilate it as soon as it is presented to them. The information acquired is of immediate practical value.

So much for the question of the recording of the work done at fully equipped and efficiently organized research stations.

There must, of course, also be records of some kind of the immense amount of " research," of " practice," and of " experiment," resulting from the labours of individual inquirers, of pastoralists and others, and notably of officers in agricultural departments.

In Memorandum No. 4, which we have before us, reference is made to two obvious defects under present arrangements ; first the papers that may be printed and published in some part of the world may not be known outside the place of origin, and may even be forgotten there after a few years, and, secondly, occasionally a valuable piece of work may not be published at all, and, in the absence of publication, either of a full paper or at least of a summary, may be entirely lost.

Of these two defects the second appears to me to be the more serious.

The Chief of one of the great agricultural research establishments in this country recently said to me that if he had had before him complete records of the work that had been done in Australia by Agricultural Departments, by pastoralists, or by individual workers, during the past half century, a very great percentage of the work that his own station had had to do of recent years would have been found to be unnecessary, or at least would have been greatly shortened, and the programme for the future could have been very materially simplified and reduced.

Some system is necessary, therefore, for the collection and publication of such records, in order that future workers may have before them everything that has been done in the past, and that is likely to prove of service.

At previous discussions at this Conference the appalling shortage of trained workers in many of the biological sciences has been emphasized, and there is not the slightest doubt that had there been efficient systems of recording, of publishing, and of interchanging the results of research, practice and observation in the past, we should to-day be able to make at least 50 per cent. greater progress with the men now available than in fact we find ourselves able to do.

From the foregoing it is obvious that there are two kinds of records to be interchanged.

First, the exact and complete records of the work done at major research stations, and, secondly, of the mass of data, much of which is of very great value, that comes from sources outside the major stations. It is probable that the system of interchange that would be most efficient in the case of the former would not be altogether applicable in the case of the latter.

The question before us, further, is to determine how best to

utilize such records to the maximum advantage in future research. The easiest course to pursue perhaps, is to find the points upon which we are probably all agreed.

There is general agreement, I think, that where a science is clearly defined, and where workers are to be found throughout the Empire, the bureau system can be adopted with excellent results.

One only needs to refer in this connection to the excellent work done by the Bureaux of Entomology and Mycology, respectively, and it would appear probable that, amongst the recommendations to be expected from this Conference, there will be one or more recommending the establishment of further bureaux of a similar nature dealing, perhaps, with soil science, with veterinary work, and possibly also with plant breeding.

May I say how much I was impressed by the discussion this morning, and particularly by the extraordinarily helpful contribution that was made to that discussion by Sir Arnold Theiler.

But whatever decisions the Conference may reach regarding such new bureaux, I think all will agree that where a bureau exists, it should be the organ responsible for the interchange of information.

Up to this point I feel that I am in substantial agreement with the general view of the Conference.

From a study of the memorandum that is before us, we find that various Committees, notably the Lovat Committee, have recommended that where no bureau exists, the Imperial Institute should act as the " clearing house " of information.

On that proposal the only discordant note in the memorandum is from Australia. One cannot, of course, fail to recognize the immense amount of work done by the Imperial Institute, or that it is capable of great extension, further to assist agricultural production ; but personally I am very doubtful of the value of any central clearing house of information expected to cover the whole, or nearly the whole, of agricultural scientific research.

Let us look a little more closely at the problem ; what does the interchange of information mean ? Two things—making every worker in the Empire aware of what other workers are doing, and watching the development of science throughout the world, in order to keep Imperial workers in touch with all recent foreign work. Why do we all approve of the Bureaux of Entomology and of Mycology ? Not merely because their direction is in the hands of distinguished scientific men, but much more because entomologists and mycologists are used to effect the interchange of information on entomology and mycology.

In other words, you do not find a mere abstracting office, but men, whose life work is active participation in the science of entomology, are called upon to survey entomology throughout the Empire and to abstract foreign entomological literature. Now, suppose there were created a central clearing house for information for the Empire. If its work was to be of any value, it would require

a huge scientific staff, and its unfortunate scientific personnel would be condemned to perpetual abstracting. They would be divorced from active participation in their particular science, and would inevitably lose touch.

It would be possible for such a clearing house to keep us all informed of what each was trying to do, that is to say, it could circulate the "bare bones" of information, but that, although undoubtedly better than nothing, is not what we should aim at.

If information is to be forwarded from all parts of the Empire to a centre, is there to be digested, and thence to be circulated again to all parts of the Empire, then the output from the centre should be so complete, and in such a form, as to be of the greatest practicable value to its recipients.

If this is to be the case, I feel certain that the centre itself must be actively engaged in just that kind of scientific work in respect of which it is to be held responsible to distribute information.

It may be objected that my remarks are not constructive, and that while condemning a single central clearing house I have made no proposal apart from blessing the bureaux.

Australia is an isolated continent, 12,000 miles away from here; the mail takes five weeks, letters to and fro practically three months, a quarter of the year; no part of the Empire needs an interchange more than we do, but no part of the Empire has greater need that that interchange should be really worth while.

Is there not an alternative somewhere between the indefinite extension of bureaux, for which I feel sure the time is not yet ripe, and a central clearing house, which I fear would inevitably give us the letter, but not the spirit—a part of the story, but not the significant part.

I venture to suggest that there is such an alternative. Where careful consideration does not seem to justify a bureau, another —a relatively simple—method appears possible. In many subjects in which a method of Imperial interchange is urgently necessary, it is possible to select a definite and specific institution which has either taken the lead in a particular subject, or which, owing to its location, may be especially suited to do so.

The selected institution, then, would be asked to undertake to act as the Empire centre of information for the one subject; and the necessary extra expense—which would not be large—would need to be met from Imperial sources.

This chosen information centre would have to be fed by every other research institution in the Empire engaged on the same problem, and direct communication between the centre and the other stations should be encouraged.

Let me illustrate my point with a concrete example. The rootstock work at East Malling is famous; my Council (the Commonwealth Council of Scientific and Industrial Research) would rather receive information on rootstocks from East Malling than from

any central clearing house. If East Malling were asked to act as the Imperial information centre on rootstocks and allied problems, it would inspire confidence overseas, and I venture to suggest it would also help East Malling. The staff there would all feel the need of maintaining the information service at a very high standard. The Director himself, the pomologist, the biochemist, the plant pathologist, and the plant physiologist, all would be actively interested in the three stages of interchange—receipt of information, digestion, and despatch of information. The men actually doing the work would live in an atmosphere of rootstocks, and might discuss at breakfast the latest report on the improvement of the Para rubber tree.

I suggest, therefore, that the Conference should investigate the possibility of making certain institutions Imperial information centres, for their own particular subjects. Apart from rootstocks, there are such subjects as animal nutrition, animal genetics, grass breeding, low temperature research, &c.

If this suggestion appears worth while, I would suggest that we might consider the establishment of a central clearing house, but only for subjects not covered by bureaux, nor for which a selected institution has been made responsible.

Even for these " left-over " subjects, I am still a little doubtful of the value of a central clearing house, and I fancy there is another alternative. I would refer the Conference to the very valuable document kindly prepared by the Ministry of Agriculture as the result of discussions between Sir Daniel Hall and my Council's representative in London. In this paper the Ministry has summarized all papers published during the past six months.

This work was undertaken to provide an illustration to this Conference of the kind of thing that could be achieved. It could be made to include notes of work in progress, as well as of finished work, and if each Department charged with the administration of agricultural science would undertake to prepare and circulate such a document, I think we might thus cover all the subjects not catered for by bureaux or by information centres.

Such a scheme would, of course, need to be carefully elaborated. In Australia, for instance, agricultural research is being carried on in a number of widely scattered establishments, and in many cases by isolated individuals, and it would be impossible for each individual to prepare and publish the kind of information that is necessary fully to inform other scientific workers of just what he had done and what he is doing.

As a result, in Australia my Council has been asked by State Agricultural Departments, by workers at universities, and by others, to undertake the task of collecting and publishing the particulars and results of work that has been done in various parts of the Commonwealth.

If this were done, I think the records so obtained would, if

properly circulated, at least keep workers in other parts of the world fairly closely in touch with what we are doing.

Whilst, however, this is a very important section of the work, I still feel that the issues at stake are so great, and the value of a scientific system of interchange of information so important, that we should carry the bureau principle as far as present circumstances will allow, and supplement it in the manner that I have suggested, by the selection of definite information centres on all matters of major research.

May I again stress the point that the best intentions and greatest zeal will not give an effective interchange of information unless the recording method is such as to enable the interchange work to be done systematically. If the scheme that I have outlined commends itself to this Conference I should like further to urge that some Imperial advisory body be appointed in London to keep in touch with each bureau and with each information centre, and to assist in the evolution of the most satisfactory systems of recording and interchange.

Dr. J. H. Grisdale (Canada): The subject before us to-day, which has been divided by the Organizing Committee into the two subjects of Imperial Bureaux and Interchange of Information, is a subject which the delegation from Canada considers to be one of prime importance in this Conference. Had it not been that this subject was being considered, we would not be here. We are here because we want to keep in touch with the rest of the Empire, and want to see organized some system of interchange of information, of ideas, of reports of workers on investigations being carried on, that will be helpful to us, and, we feel, useful to the rest of this great Empire and, possibly, the world.

I listened this morning with the very greatest of interest to Mr. Ormsby-Gore's outlining of the situation as he sees it. I followed as closely as possible the remarks made by gentlemen who were asked to participate in this discussion after Mr. Ormsby-Gore's address, and I have listened very closely indeed to the able paper just read us by Mr. Julius. The question of the establishment of bureaux seems to be one of primary importance, and seems to be the way in which the information at our disposal can most readily and most easily be "put across," to use that expression. We have had some experience in this connection. We have had the Bureau of Entomology for the last 14 or 15 years. We have had a Bureau of Mycology for some few years. We in Canada have been very well pleased with the benefits which have accrued to us from these bureaux. Our entomologists keep very closely in touch indeed with the work carried on in the bureau here under the able direction of Dr. Marshall, and we feel we have in him and in his staff, friends and co-operators who are invaluable in the work we are carrying on in Canada, looking to the elimination, or, at least, the control of insect pests. In our mycological work the same thing

is true. We look to Kew and, particularly to Dr. Butler, for information, and get it ; that is exceedingly important. Consequently we feel that in the organization and carrying out of bureaux, in some way, not necessarily absolutely along the lines which are at present maintained, lies the solution of the great problem with which we are contending, i.e., the getting of information from all parts of the Empire, from all parts of the world, and the getting of it in such shape as will enable us quickly and readily to use it to our advantage.

I listened to Mr. Ormsby-Gore outlining the idea of bureaux, and his idea of the limitation of the numbers appeals to me, but not quite so strongly as it did, apparently, to some others. I believe we might have a few more bureaux than has been suggested by Mr. Ormsby-Gore. Mr. Julius in his remarks apparently is in favour of the establishment of a number of bureaux, and then he supplements that by suggesting centres where information would be collected and disseminated or to which you would apply for information. With all due deference to Mr. Julius, I hardly see the difference between a bureau and a centre such as he suggests.

Dr. Marshall this morning referred to the fact that the work should be begun in a small way. Now, I do not know whether Dr. Marshall meant that his bureau had started in a small way and had grown up. He started in a very small way because he was the first, and he has grown very leisurely, too leisurely, in our opinion, for agricultural research and agricultural work in the Empire. I have discussed this with the Canadian Delegation, and I suggest the following as the possible bureaux to start with, in addition to the two already in existence : (1) Animal Nutrition ; (2) Animal Hygiene ; (3) Genetics, Animals and Plants ; (4) Soils ; (5) Economic and Systematic Botany. Under animal hygiene we would include any, or practically any, line of work in connection with veterinary science that might be thought possible of incorporating under that heading.

We have in the temperate zones, to say nothing of the tropical regions with which I am not familiar, a number of diseases which are of world-wide importance. Bovine tuberculosis, abortion in cattle, and animal parasites are to be found the world over. There are a number of other diseases which might be mentioned which are common to the world. Therefore, it seems to me that to neglect taking some measure at this time when we are here met together in a Conference such as never came together before, and possibly never will again, would be bad, and indeed this is the time in my opinion to take some action. I suggest under animal hygiene we might be able to bring a bureau into existence where information along those lines could be brought together, tabulated, analysed, and possibly amplified, as you have here an excellent opportunity of doing—not because you have so much disease, but better facilities for study, and giving out to the world.

In addition to that under economic botany we should like to see something done in connection with fruits, flowers and vegetables. They are of great economic importance, possibly no one of them or even the three of them are of sufficient importance to justify a bureau being organized and established, but they are of very great importance indeed in all temperate countries, and consequently, we think, should receive some attention.

Under soils I need not dwell upon the points which need consideration. Sir John Russell this morning dealt with them fully and spoke very fittingly indeed and very much to the satisfaction of Canadians.

As to where these bureaux should be located is a matter of very great importance. We have heard different points mentioned as suitable for the location of these bureaux. We have considered amongst ourselves in the Canadian delegation, and we feel that Great Britain is the place for them all, not because there are not suitable locations to be found elsewhere, not because Great Britain has a monopoly of good research stations of one kind or another —South Africa has some most excellent research stations, we feel that Canada has some very fine research stations, we know Australia has some good ones—but because Great Britain is the Mecca or the point to which we all come sooner or later, the home country, and here, therefore, we could all meet at some time or another and get in touch with these bureaux, and that would add very much indeed to their value.

As to publications, I listened with not very clear understanding possibly to some of the remarks made this morning. If I interpreted the remarks aright some of the speakers suggested that some central specialist publication should be issued under the ægis of the bureau in which research reports should appear for the first time. Now, Canada could not agree to that. We must have the right to publish those as we receive them in our own country. They could also at the same time be sent to the bureau for publication in their specialist publication if so desired, but we feel that we could not submit to anything like giving precedence in the way of publication to any centralized organization such as this.

Then as to the reference that was made by Mr. Julius to the Imperial Institute. I admire that Institution very greatly, I know the Director, I have visited it and gone over it very carefully under his personal guidance, and know just what is being done, but, as Mr. Julius said, to make that a clearing house for information of all kinds would either necessitate the establishment there of a staff of experts or else it would mean that the work would be done in a very perfunctory and very unsatisfactory way. Consequently I am inclined to agree with Mr. Julius that we had better have centres outside, centres where work is being carried on of that character in a special way. As to where some of these bureaux might be located, it occurred to us that the Rowett Institute would be a good

centre for animal nutrition, that Rothamsted would be a most excellent centre for the bureau of soils and so on. I am just giving those as instances.

We feel, however, that this Conference should not break up without having done something not only to indicate our preference and our ambitions along these lines, but to show definitely and emphatically what we want to do in the way of getting these things across and establishing these bureaux. Consequently we feel that this is the most important matter in this whole Conference and that the action that should be taken on our proceedings to-day is an action of the greatest consequence to this Empire of ours and its life.

Sir Daniel Hall (Ministry of Agriculture) : The idea of bureaux of information has been very generally blessed, and that without doubt is due to the very manifest success which has attended the Imperial Bureaux of Entomology and Mycology, but we want to distinguish a little. It may only be a question of nomenclature whether we call it a bureau or not, but some of the warnings which Dr. Marshall addressed to us this morning with regard to his own bureau ought to be borne in mind, that the bureau organization proper is perhaps only applicable to a subject which in the first instance is very strictly defined, and, what I think is of more importance still, to a subject which possesses in all parts of the Empire a definite service with administrative functions, the officers of which can be regular correspondents of the bureau. These are the essentials of what you might call the strict bureau idea, that there is administrative work to do, and information to be exchanged between officers actually engaged in that particular type of work. The bureau organization is only likely to succeed when those conditions are fulfilled. Now, these conditions are not fulfilled for a great number of our subjects, and if we attempt to impose as hard and fast an organization as that of a bureau on the other subjects, we are rather likely to break down.

Take, for instance, one very important subject which Sir Arnold Theiler has put before us, that of veterinary science. At least one condition of the bureau is fulfilled, i.e., there exists a service of officers with administrative duties to perform. There is probably very ample scope for a bureau of this description, provided it will not attempt to cover the range of veterinary science but will rather confine itself to questions of veterinary administration, and dissemination of information about such examples of successful attack and control of disease in one area as may be of extraordinary value to other areas. As regards the scientific part of the work there exist, of course, several journals which are in the hands of all serious investigators and which cannot be displaced as the agencies for disseminating primary information, but it is just this secondary kind of information on the application of research and the administrative control of disease which can so profitably be interchanged

between service men who have the job to do under all sorts of varied conditions.

When one comes to discuss some of the other subjects which have been raised, I do think that the bureau idea proper is not applicable to the pure sciences where, of course, recognized agencies for publication exist, nor to those other subjects such as animal husbandry where the body of the work is not being carried out by officials, but by the whole general body of farmers. Such a subject is too vague, too loose, too general, and in a sense too enormous, to permit of the system of correspondence backwards and forwards from the centre and the collection and dissemination of information that is the essence, as it were, of the bureau system.

I should say the same of some of our applied sciences. Take, for instance, soil science. Soil science cannot be bounded inside the Empire, it is an international affair. There exists already an international organization on soil chemistry which meets at periodic intervals to exchange methods, and discuss theories. Anybody seriously engaged in the investigation of soil matters must get contacts with the international body, and cannot be content with an Empire substitute. I doubt if the bureau system is properly applicable to such a subject as soils.

However, when we say it is not properly applicable, what else have we to put in its place ? We desire to organize some method of exchange of information and, I think in that connection it would be well worth following up the suggestion that Mr. Julius put before us of correspondence centres. If for each of our recognized divisions of agricultural science there was some central place, some central research station, to which all workers in the subject could feel that they had a definite right to apply for information and where some machinery existed for supplying that information, it would be good. It is obvious that it would be extremely valuable to workers in soils if they could correspond with Rothamsted. They could write to Rothamsted, they could get papers looked up for them, digests made of work done anywhere in the world on some particular subject ; they could get information about apparatus and methods, advice as to the attack on a problem and so forth. If they had such a correspondence centre they would often be in a position to save themselves much time and be spared a useless pursuit. I can conceive again about genetics that it would be very advantageous to have a centre to which plant breeders in some of the outlying parts of the world could apply for information. Let us suppose a man in Central Africa is dealing with a particular plant. He is suddenly seized with an idea that it would be desirable to have the cytology of this particular plant investigated. He is not a cytologist himself, nor does he know how to set to work. There would be someone to whom he can write, who will tell him what methods to employ, or possibly say : " Instead of doing it yourself, if you will send such-and-such material to us prepared in such-and-such a way we will

give you a preliminary survey of the material and tell you whether it is worth while following up." I believe, therefore, the idea that Mr. Julius threw out of correspondence centres is likely to be more fertile on many of these big wide-spread subjects than a more definite administrative bureau such as the two which are already in existence.

May I turn to another subject, the question of diffusion of information? Let us be quite clear that as regards high research the real research worker does not want any more machinery for the dissemination of information. The man who is deep in his subject, whether it be soil, genetics, or animal nutrition, knows the sources of information, and the people to apply to, and he can get to them without further assistance. It is the solitary workers, and the workers a stage lower, on the type of work that is not pure fundamental research, who need helping. Now we have, following out our ideas at the Ministry, published a little document showing the kind of bibliography which we think might be prepared by every country for the work that they have done, which then might be gathered by some central organization and disseminated again to the periphery. There is only one thing I would say about that particular document—it is a little too long. There are abstracts covering a page and a half. I don't believe we want abstracts of that type. First of all, to the real scientific worker no abstract is any good; he must get at the *ipsissima verba*. He just wants sufficient guidance as to whether the paper is really—the title alone does not always tell him—dealing with the particular aspect of the question in which he is concerned. We want, as it were, the author to supply an enlarged title, and I believe he can do it in 100 words. He has been asked, for that particular document, to do it in 200 words. Well, very often he took 500 words—that may be either vanity or a lack of skill, but we have got to put it to him that he can do it in 100 words and he will do it better in 100 than in 500. If we can organize some machinery by which those enlarged titles are brought up to a centre and disseminated again from that centre we shall do almost as much as is possible in circulating these results of work that is actually being done.

One word more. Let it be only a record of work which has been done. Do not let us be led away with the idea of circulating notes about work in progress or work that is projected. Nothing is more dangerous to the actual worker than to be liable to a premature fire of that description—I quite agree that sometimes a distant worker may want to butt into a particular field and would like to know if somebody else is working on it. Let him turn to the correspondence centre and see if they know of anybody working on that line, but do not let us contemplate publishing either programmes or projects of research or work which is in progress.

Dr. J. H. Grisdale (Canada): What is a bureau?

I was in an institution the other day, since I came to this country, and they were giving us some idea of how they started with their

work. I was told that before a man undertook a piece of work he was required to spend, I think it was six months getting in touch with the bibliography of the subject: then work a little while and then spend six months more getting in touch with the bibliography of the subject, and by that time he was supposed to have it pretty well in hand. Would that not be an example of some of the work a bureau might do, or could do?

Sir Daniel Hall: I think Dr. Grisdale has given an answer to his own question. That man is a bureau.

Dr. J. H. Hinchcliff (Irish Free State): On the subject under discussion several speakers have mentioned the isolation of their workers. Dr. Reakes, of New Zealand, when speaking this morning said he spoke as representing perhaps the remotest part of the British Empire. I have the honour to speak on behalf of that part which is in closest proximity to this country. It is because of that close proximity that our workers are able to maintain constant and personal touch with workers on this side, but despite that personal touch we of the Agricultural Department and the scientific workers in the Irish Free State have received the greatest possible assistance from the two bureaux which have already been established, and it is because of the success of those bureaux and the help we have obtained from them that we approach the proposal for the extension of bureaux, either extension of the existing ones, or an extension in number, sympathetically. Mr. Julius this afternoon mentioned the necessity, if the bureaux were to do the work he envisaged, of their being staffed by an expert staff. With that I am in hearty agreement. My colleagues assure me that the abstracts and reviews they have got from the two existing bureaux are really more helpful than other reviews and abstracts, simply because the heads of those bureaux and their staffs are experts in their particular subjects and can, therefore, take out of any publication or scientific paper the most important parts for other scientific workers. I am, therefore, in hearty agreement with Mr. Julius, that if we are to have further bureaux they must be staffed much on the lines of the existing service. If there is to be an extension, as an administrative officer it would devolve on me, as far as my own country goes, to represent to another authority, namely, Finance, that these services are necessary, and to try and persuade that all-powerful body, the Department of Finance, that they would be justified in making contributions to them, and I should, therefore, have to show in due course, if, as a result of this Conference, further bureaux are established, that the work which those bureaux propose to do is not done already by the existing services, some of which are international and to some of which my Government already contribute. I, therefore, would ask the Conference to consider carefully the point which Sir Daniel Hall has raised, namely, that there are services, perhaps not exactly bureaux—I shall not quarrel

with Dr. Grisdale about the definition of bureau—in existence which give assistance to scientific workers that possibly some of us thought might have been done by further Imperial bureaux.

I have said already that, on behalf of the Irish delegation, we approach this proposal sympathetically. We had not any very definite proposals to put forward. We came to listen and with the idea of helping perhaps in Committee. I do not wish to commit myself at the moment as to the bureaux we thought might possibly be established, but I would perhaps say this, that as regards dairying —I notice Dr. Grisdale did not include dairying, unless he meant it to be included in one of his divisions of animal husbandry—we did think possibly that some useful work might be done in connection with dairying either under veterinary science or some branch of animal husbandry for the very reason that Dr. Reakes advanced this morning, namely, that a big share of our trade in agricultural produce is in cattle and animal products, and, for that reason, we shall contribute, as far as we can, to the discussion in Committee of any proposals that may come up in regard to the establishment of a bureau for some branch or other of animal husbandry.

Dr. F. J. F. Shaw (India) : I am sure we are all agreed that the efficient dissemination of scientific information throughout our Empire is one of the essential conditions for the successful co-operation of scientific investigators in the different and widely separated parts thereof. We are seeking for the best machinery for ensuring success in this matter and the Government of India have placed before this Conference a memorandum on the subject of a Publicity Bureau in London, a central organization for the collection and dissemination of scientific intelligence. It is necessary for me at the present moment to remind the Conference that we have a Royal Commission on Agriculture in India of which we are fortunate in having a member present with us. I have to say with regard to this memorandum on the desirability of a Publicity Bureau that while the Government of India accept responsibility for the facts stated therein they do not, pending receipt of the report of the Royal Commission on Agriculture, commit themselves to the acceptance of all or any of the views expressed, and, moreover, the Government of India must reserve their decision on any conclusions which this Conference may reach on this subject and on any other subjects which are likely to have a bearing on those dealt with in the report of the Royal Commission. Therefore, anything which I say is merely my own opinion and has no other weight than may be attached to my personal views.

The research worker all over the Empire needs early intelligence of work which has been published in his own field, and of work which is in progress in that field. With regard to published work, particularly work which is published by Government Departments, I think we should all see that we have a generous distribution and exchange list.

With regard to work which is in progress I should like to associate myself with Dr. Butler in saying that I consider the writing of annual reports by scientific investigators is a very necessary thing. It is possible that the writing of annual reports is not sufficiently general or, what is more likely, that even where they are written their publication and distribution by the authorities to whom they are submitted is not sufficiently wide. These things carry obvious remedies. But the generous distribution of publications, reports, &c., is not in itself the most efficient means for the dissemination of information. We have before us in the examples of the Bureaux of Entomology and Mycology what I consider to be the ideal method for the collection and dissemination of information.

It is, however, necessary to recognize that we have, in entomology and mycology, two subjects which are peculiarly suited to the bureau system. In both cases the maintenance of type collections, with which specimens can be compared and identified, is a matter of extreme importance and anybody who has worked, as I have, in an out-of-the-way part of the Empire will know how necessary this assistance is. Again, these subjects have the very great advantage that the actual material with which they deal is easily transported. It is possible to send cultures of a fungus from a distant part of the Empire to the Imperial Bureau of Mycology, and for that culture to form the starting point of an investigation which will be of great benefit to the country from which the organism was originally sent.

It seems to me that in some other subjects, in which it is proposed to form bureaux, the collection and dissemination of information in those subjects would form a relatively very much larger part of their activities than this work does in the case of mycology and entomology. I do not mean by that that mycology and above all things entomology is deficient in a copious literature. It is not that, but the point is that in mycology and entomology the bureaux which deal with those subjects have so much else which they can do.

It might be possible in the case of some of those other subjects, supposing the expense of establishing bureaux is not considered to be justified, to create relatively inexpensive organizations—the word correspondence centres has already been used—by the development of existing institutions. I refer particularly to the possibilities of Rothamsted becoming a centre for the distribution of information on soil science, and Cambridge for plant breeding.

Finally, we have the alternative which the Government of India has suggested, the establishment of a Publicity Bureau which would be a central organization for the collection and dissemination of information. I think I should explain exactly how the idea of a Publicity Bureau arose in India. It came under the observation of officers of the agricultural service that some of our more progressive Indian landowners were in the habit of subscribing for the bulletins

and popular journals which are issued by the United States Department of Agriculture, and it seemed to us that the need for this type of information should be met by some publication published within the Empire and dealing mainly with Empire agricultural matters. This is not a side of the subject of the distribution of information with which we are concerned at present. I give it merely to explain how the idea of a Publicity Bureau arose. The chief advantages of a Publicity Bureau can be summed up in two words, economy and centralization. Economy in the charges, what I might term the overhead charges of administration, clerical work, publication; centralization in that we should have one common centre to which we should send all our publications. I do not propose to go over the arguments in favour of a Publicity Bureau at present. I think it would be better if I reserved those for the Commission which will sit on this subject. Of course, the danger to my mind in a centralization of the collection of information is that it would inevitably result in the loss of that personal contact such as exists between the heads of the existing Bureaux of Entomology and Mycology and the workers in those subjects.

I have no doubt that other speakers will contribute their opinions of the advantages of the centralization of the collection and dissemination of information. Coming, as we do, from widely separated parts of the Empire, with widely differing experiences behind us, it is inevitable that we should bring different views to the solution of any problem, but with a common will to co-operate I have no doubt that we shall devise a means by which we shall all benefit in this important subject.

Dr. J. B. Orr (Rowett Research Institute): It would be difficult to find one uniform system of exchange of information which would be equally useful to all the different branches of research; therefore any remarks I may make will have reference only to animal nutrition, the subject in which I am interested. I quite realize, however, that any suggestions I may make with regard to that subject may not be at all applicable to other branches of research.

In connection with this subject, the distinction which Mr. Ormsby-Gore made between pure and applied science is a very real distinction. We who are investigating problems of animal nutrition are not so much interested in physiology as such or biochemistry as such. We are faced with practical problems, and the information we want is not systematic information grouped according to artificial division and sub-division of science, but information which has a direct bearing upon the practical problems we are dealing with. Let me illustrate from an investigation going on at the present time. Several of us throughout the Empire and in other countries have for some time been studying goitre and certain allied conditions, which are believed to be associated in some way with deficiency of iodine in the diet. We wished to get all the available information bearing upon this subject. We began with the literature

of physiology and biochemistry; we were forced to go on to plant physiology; then on to soils and ultimately even to geology and clinical surgery, so that we are dealing with abstracts of literature from a great many different branches of science, which, so far as the literature is concerned, are fairly well defined. Now, a bureau system which would systematically abstract the literature of all these different sciences would mean an enormous structure which would break down under its own weight. I suggest, therefore, that in connection with this subject at least the proper method is not to abstract literature according to branches of science, but first to visualize the big problems on which we are working, and then to collect information from whatever source it can be found round the problems. There has got to be a grouping of information which we already have towards each specific problem, and when a new problem arises there has to be a re-grouping of the same information towards the new problem.

Now, that involves that the collection of the information will need to be done by men who have a knowledge of the problems to which the scientific information has to be applied and that further involves the principle that the abstracting and collecting of information has got to be done by the research workers themselves. You may give them clerical assistance, but in the last resort the available information has to be collected and grouped round the problem by the men who are intensely interested in the problem for which the information is being collected.

That brings us to another point. Every research worker knows that there is a great deal of information which is available within the heads of the research workers, but which may not be published probably for years. If one could devise a system of bringing together that information which has not yet been published, which, indeed, may never be published, it would very markedly increase the value of the exchange system. I speak with personal experience of this. For example, in connection with goitre, the subject I have mentioned, we got in touch with workers in Canada who were working at the subject from a totally different point of view from ourselves, and we exchanged information with them. Whether our information was of any value to them I do not know, but certain information we received from Canada enabled us to take a shorter cut to our objective, and so save both time and money. In the same way in the case of another investigation, personal contact with those interested in New Zealand enabled us to get on the direct lines sooner than would otherwise have been done. Similarly we got new ideas from Dr. Cameron, of Australia. I met him, and, in discussing a subject on which we in Scotland were interested and to which we were devoting a good deal of time and money, found information dropping from him like ripe apples from a tree. He did not seem to realize the great value that information, which he had acquired and which he had never put on record, was to us. Indeed, I under-

stand he had no intention of ever putting it on record. I quote these instances to show that it is often as important to pool the live unpublished information as to collect abstracts of published papers.

This is my notion of the way information on animal nutrition should be collected by a bureau. First visualize the problems, then get into contact with the people who are working on these or allied problems. Set apart someone with a knowledge of the problems and of the sciences concerned to review and abstract the literature, and arrange the abstracts in a convenient form. These should then be issued to the workers interested asking them to send in any further information which they may have. If a method something like that were thrashed out, it would enable us to begin an exchange of information on the main problems we are now working at. The information collected would be the very information workers are waiting for, and would have an immediate bearing on the problems being studied. There would, therefore, be a chance of an immediate economic return for the money expended in collecting the information.

We have discussed the question of conferences. This suggestion of grouping information round a problem should be extended to conferences of workers. We need conferences not of physiologists, plant breeders or soil chemists as such, but conferences of men interested in definite problems, no matter what branch of science these may regard themselves as belonging to. That is to say, we should try not only to group the information round the problem, but also to group the workers round the problem. May I again give an example of what I mean? In the near future I expect there will be a conference in London to consider a certain subject of great importance in public health. Sitting round the one table there will be physiologists, physicians, medical officers of health, and also Sir John Russell, whose main interest is soil. These men are permanently interested in every branch of science, but are united temporarily in an interest on the specific problem to the solution of which all their sciences can make a contribution.

Colonel G. N. Williams (South Africa): I hesitate rather to use the word "bureau" in view of the enquiries dealing with the word, so I will rather speak of it as a central unit or co-ordinating centre of research. Might I say in South Africa we are unreservedly in favour of establishing the principle of these bureaux, but as Dr. Hinchcliff pointed out the element of finance is not entirely disconnected therewith. We would only be prepared to adhere to one or two additional bureaux beyond those at present existing, and I do not think we could contemplate the establishment of five or six all at one time. Parliament is always very chary about grants-in-aid, and these things require a considerable amount of explanation, and I am sure the Government of South Africa would not face expenditure in this respect; but we are unreservedly in

favour of the principle of gradual extension of these bureaux and first in order of priority we place the establishment of an Institute of Animal Hygiene, or Veterinary Science, call it what you will.

In regard to the question of the dissemination and interchange of information, that is a matter that has been exercising our minds to a very great extent just prior to my leaving South Africa to attend this Conference. It is again a question of £ s. d. A great many of the scientific publications that are issued in South Africa are of little or no interest to South African farmers, but we have felt it in the past to be our duty to contribute our small quota of scientific knowledge, and we have printed these documents often at a very considerable cost. For example, the last report of Sir Arnold Theiler cost us £2,000, and we are at present spending £400 —up to even £800—on the publication of individual scientific reports. We have had a warning note in regard to printing. Our printing bill is getting far too heavy, and I have already taken steps to cut it down by one-third. Our annual report is purely an administrative document. It professes to be in no way a scientific report, and we would not consider the question of annual scientific reports. We prefer to publish scientific reports as the work is completed in separate documents. We have a very generous exchange list; almost every English-speaking country in the world and a great many countries that are not English speaking figure on our exchange list. We shall have to curtail our output of scientific reports which are not read in South Africa. We must devote as much money as possible to popular agricultural literature and propaganda.

It has been suggested in the memorandum from India that a central association should devote a portion of its funds to the issue of popular literature on agriculture and veterinary science. With that view we are in disagreement—I am speaking for South Africa —we feel the psychological conditions and various other factors in South Africa are such that popular literature for the South African farmer can be written by no one without an intimate acquaintance with the country and the people. We would not associate ourselves with any combined movement in regard to popular literature.

In regard to scientific literature we feel we have a distinct duty to perform to the rest of the Empire. It would be greatly regretted if reports which would often be of very great value to workers in other parts of the Empire were pigeonholed in our Department. Fifteen or twenty roneod copies of any of these reports would amply serve our purpose. I have, therefore, a suggestion to make. Whether the Imperial Institute (as has been suggested) would be the best medium for the purpose I am not in a position to say. We want to start on fairly simple lines. Some means should be found whereby valuable scientific reports which after being acted on by the country concerned would never be seen by scientific workers in other parts of the world should be made available. This is a question of co-operation—and, of course, countries interested

will have to contribute towards the expenditure in regard to this matter. (I should like to say we feel very strongly in South Africa we do not want any benefit whatever unless we pay our full quota towards the cost of such benefits. That is a fundamental principle to us.) Where bureaux are already established or where they will be established, they undoubtedly will be the media to be used for this purpose. My suggestion is this, that the Departments concerned will know when they receive a report, and they do not intend to print and publish it, whether that report is of sufficient interest to warrant sending it to some central institution here in London. I do not think that the institution need necessarily be equipped with a staff of specialists because there are always other institutions to which it can refer for scientific opinion on the question of whether the report was sufficiently valuable to other parts of the Empire to justify it being printed. I am here talking only of the publication. Any abstracts that would be required afterwards would be undertaken by individual research workers or individual institutions concerned, but the great point is that these reports should be able to see the light of day. By using some existing institution, the Imperial Institute on the one hand and the bureaux where they exist on the other, we can accomplish this at comparatively small cost. Dr. Marshall this morning, I think, mentioned that these reports would be sold so that such a venture would be self-supporting. We should take that into account, and the various Governments interested would be called upon to guarantee to make up any deficit upon some scale to be agreed upon. I make this as a practical suggestion which may enable us to find a simple and easy way out of the difficulty which would not cause any controversy or outrage any principles of any Dominions or Colonies.

Mr. H. C. Doyne (Sierra Leone) : May I address the Conference as a junior agricultural chemist from a small colony, on the subject of soils? Mr. Ormsby-Gore proposed a Bureau of Soils, and what we require is the form of bureau suggested by Sir John Russell this morning. The main functions of such a bureau seem to me to be these. (1) To give, on request, direct information or information as to literature, on the work already done or being carried on on any subject connected with soils. (2) To deal with special research problems which are outside the capabilities of the colony concerned. (3) To work out new methods of analysis which may originate or be suggested by a colony where the means and the time to work out these new methods are unavailable. (4) To enable workers from the Colonies to visit and work on their own problems or study new methods and consult literature when they are on leave. (5) Possibly, to supply additional workers who could be sent to various colonies temporarily to investigate individual problems. (6) Finally, to sift and disseminate all research work in connection with soils both from within and from outside the British Empire, and to circulate a summary of this in a monthly bulletin.

Sir Herbert Read (Mauritius) : We should consider not merely the question of the creation of new bureaux, but also the question of improving the organization of the existing bureaux. It seems to me that very valuable results could be obtained if provision were made on the staffs of the Bureau of Mycology and the Bureau of Entomology for a certain number of travelling experts. If the scheme for the interchange of workers between the colonies were approved contact would be established between the colonies themselves. There is also a further provision for that in the periodical conferences we hold in certain parts of the Empire, but what we have not got at present is complete contact between colonies and the workers in this country. It seems to me that experts of that kind would be of the utmost value. Very often the local Director of Agriculture is faced with a difficult problem and is anxious to discuss the matter with some other scientific man. Then again there may be research work which affects several colonies, and a man who is travelling round from place to place can pass on information obtained in one colony to the workers in another. He would also be available as a stopgap if necessary, and in many other directions it seems to me that he would be of great value. I think the ideal arrangement would be one expert for the West Indian group ; one for the East Indian group ; one for the West African group and one for the East African group. Whatever is done will take a certain amount of time as the men are not available at present.

Then stress was laid by some of the speakers on the importance of proceeding gradually with the creation of new bureaux. I am certain that that is a very wise course to pursue. There is no doubt that, in some of the colonies at any rate, there is a reluctance to contribute to organizations in this country when so much remains to be done to bring their own local departments of agriculture to a proper state of efficiency.

Then one other point, the organization of the Imperial Institute as a clearing house of information. I must say I am very much in agreement with what was said by the representative of Australia, at any rate so far as the Bureau of Entomology and the Bureau of Mycology are concerned. The present arrangement has worked admirably. I see that the proposal is put forward very tentatively in memorandum 4. It says :—

> " There is perhaps something to be said for a compromise, viz : that there should be one body to whom all the lists of papers and summaries should be sent . . ."

and then it goes on to say :—

> " The concentration would *prima facie* mean economy in expenditure."

I am not certain that that would be the case, but it seems to me that as regards these subjects, which are of interest to more than one

bureau, it would be quite sufficient to arrange that the reports should be sent to all those bureaux and that there should be periodical conferences between the Directors of the respective bureaux. That would be sufficient to maintain touch between existing organizations.

Dr. A. W. Hill (Kew): In connection with what Sir Daniel Hall has said about correspondence centres of information and what has been said in regard to making use of existing organizations where there are people competent to deal with specific problems: the value of Kew, in connection with systematic botany, has been recognized by the Governments of India, of South Africa and West Africa, who provide us with special assistance for dealing with the floras of those particular parts of the world. It seems a cheap and very efficient way of enabling existing institutions to help forward the work and of making use of them, as correspondence centres for information.

Mr. P. H. Lamb (Nigeria): As representing Nigeria I should like to say how very much I welcome the remarks made by Sir John Russell this morning when expressing his willingness that Rothamsted should be a Bureau for Soil Science. In recent years we have looked to Rothamsted for very important researches in soil bacteriology and to Sir John Russell in particular, and we in Nigeria feel we are on the eve of further very important discoveries in the nature of the soil bacteria and their activities, and we cannot help feeling that, by having Rothamsted for a central bureau for soil science, any researches we and other parts of the Empire may make on these lines will be greatly accelerated and facilitated.

As regards the exchange of publications the Nigerian Department issues an annual bulletin in which full and detailed accounts are given of the experimental work we are carrying on and also of research work which is being done. This bulletin is primarily printed for our own purposes as a permanent record of the work the Department is doing and will obviate any possibility of work being lost in the way in which it has been in the past, but this bulletin is also used for the purpose of exchange with other colonies, and we, like South Africa, have a very comprehensive exchange list, and it is extremely gratifying to us to see that this bulletin is appreciated by other parts of the Empire, for they have actually ordered from us not only one or two copies, but several copies for distribution among their staff. We feel that in West Africa we have not got the facilities at the present time for issuing any more comprehensive agricultural publications than we already do, but we welcome the prospect of being able to send this bulletin in its present form to any new bureau which may be formed where it can there be extracted for the benefit of other parts of the Empire.

Professor G. Scott Robertson (Northern Ireland): On behalf of that small portion of the United Kingdom, Northern

Ireland, I should just like to say that we are in such thorough agreement with the views that have been so ably put forward by Sir Daniel Hall, and with the suggestions which Mr. Julius, of Australia, has made, that I do not think I should be justified in taking up the time of the Conference at this stage in endorsing them in detail. It does appear to me that we are suffering this afternoon in the course of our discussion by, as Dr. Grisdale pointed out, lack of definition of the term "bureau." We all quite clearly understand the duties and the functions of the Bureau of Entomology and the Bureau of Mycology, but I find it difficult to conceive of a Bureau of Animal Nutrition or of a Bureau of Soils. Some of us are rather apt to look upon the Bureau as if it were a super-research station. Many of the suggestions that have been put forward as to how the Bureau on Soils should work almost envisage a sort of new super-research station, and it does seem to me we shall have to hammer out in a somewhat clearer manner what we mean by a bureau and by a research station.

Sir William Furse (Imperial Institute) : The Imperial Institute was the first start made in this scheme of having clearing houses for information of this kind throughout the Empire. Whether we have done as much as we could have done during those thirty or forty years is another matter altogether, but let me say, as the present Director of the Institute, that my colleagues and I are only too ready to hand over, just as has been done in the case of entomology and mycology, to any new bureau or any new centre for more specialized collection and dissemination of information the clearing house work that we are trying to do and shall continue to do until we are told otherwise. I am glad to say that I have had testimony from many parts of the Empire of the practical value of our reports, based on investigations of sample products, as to their economic value as products, i.e., raw material for commercial industrial uses. In the course of time, as colonies turn into dominions and dominions into nations and industrial nations, it is only natural that the use we perhaps were to those original colonies thirty or forty years ago may not be so great now. They have their own splendid research stations and their methods of investigating products and comparing them with past samples and so forth, but we still believe that we can be and are of practical use to what I may call the junior, smaller, colonies, and especially in the Tropics. May I further say that what we are hoping for always from this and other similar Conferences are quite direct help and suggestions as to how we can be of greater assistance to any part or to all parts of the overseas Empire.

Lord Lovat (Dominions Office) : I would like to amplify the point raised by Colonel Williams, that there are in all probability —in fact I would say as an absolute certainty—reports being made in various parts of the Empire which are cut out, especially in the

Non-Self-Governing Colonies, of the annual report, and which are very often lost altogether. On the three Committees on which I have served on this subject this statement was made over and over again, and I have no doubt that it is founded on fact. Colonel Williams suggested that these reports should be sent to a centre from which they could be despatched to a particular bureau, and Mr. Julius made the suggestion of a centre to which information might be sent to be reported upon and finally published from the centre. I think that would be of real value to the Empire.

In the second place, there is one point we have to look to, and that is that whatever is decided as to the number of bureaux, or centres of information, or whatever they are going to be, it will probably be necessary to have an organizing centre somewhere, someone who will be able to say of those reports which touch on two or three or more sciences, or two or three or more interests, where they should go, and how afterwards the work of distribution should be done. I think there must be an organizing centre in such circumstances as those.

A Committee, of which I formed part, suggested the Imperial Institute for the purpose, to a large extent with the idea that in the Council of Plant and Animal Products at the Imperial Institute there is an organization which is dealing with subjects from the individual product side, and is in close touch with the trade. For a long time this country will be the largest consumer of the products, and touch with the trade is a most important point and will give a reality to applied research which sometimes it might otherwise lack.

Mr. G. G. Auchinleck (Gold Coast): Listening to the discussion on the question of annual reports between Dr. Marshall and Dr. Butler, I was rather tempted to say something about this point. Every department of agriculture is faced with the difficulty of turning out an annual report which is an administrative report, and which at the same time, contains the results of the work of its officers which has taken place during the year, either current work or isolated pieces of work. The Ceylon Department two or three years ago started a year book which was a summary of the scientific work, very short and fragmentary, done by the officers during the year, which was published separately from the annual administrative report. That was followed, I believe, by Nigeria, as Mr. Lamb told us, and that department published an annual bulletin similar to the year book except that the papers were fuller and longer. The Gold Coast for the past year has published a similar publication with the result that their annual administrative reports have been cut down to about 10 or 12 pages, giving the Government a general administrative outline of the departmental work during the year. I think this type of year book and annual bulletin would probably exactly meet the request put forward by Dr. Butler. Our year book in the Gold Coast has just reached

me, and I think Dr. Butler after seeing that would realize that some publication of that kind is cheaper, as effective, and probably imparts exactly the information he would desire for his work.

I will give a few details about it. It has about 20 or 21 papers dealing with work of the different departments, prefaced by a general statement by the Director of Agriculture. These 20 papers average somewhere about 5 pages each, and they are of two kinds. Some of them are summaries of very lengthy work done by officers, work which has appeared in bulletin or book form during the year and is merely summarized in the year book. The other type is possibly even more interesting because it deals with small pieces of work of value done by officers during the year, too short to make a bulletin or book, but at the same time important enough to warrant it being published in some form or another. Our year book I do not think will cost more than £100—probably nearer £50.

I should like to press every department of agriculture in other parts of the Tropics and the temperate zones as well to adopt something similar; in future to confine themselves to purely administrative matters in their administrative report and publish a separate year book, annual bulletin, or whatever it may be called, of scientific work.

7.—Periodical Conferences.

Friday, October 7th, 1927.

Colonel G. N. Williams (South Africa): It is with great pleasure that I rise to open the discussion on this item of the agenda. I consider it the most important item we have before us. You may talk of erecting bureaux and of joint action and all those other things which are most desirable, but until we get a complete feeling of sympathy and understanding between the various persons whose business it will be to carry out these proposals I fear anything which we may do will fall far short of the mark.

The case for these conferences is very ably set forth in memorandum 5* of the agenda, but there is one aspect of the matter which is not referred to, probably because it is so obvious that it is thought unnecessary to labour the point, but I feel that, after all, while we may agree as to the desirability of conferences, the respective Governments which we represent may not be quite so enthusiastic, and it will be for the Conference to make out a case so convincing that even the most niggardly Treasury in the Empire will fail to withstand the force of our arguments. The very essence of this Conference is to ensure co-operation throughout the Empire. We all know the petty jealousies that arise between the various Governments and between Government Departments. That cannot be unknown to anybody in this room, and the way to eliminate

* Appendix B, p. 232.

these things is that we should meet together not only for the exchange of views, but to get to know the man. Not only is it important to understand the man's work, but we want to understand the man himself. So much for that point.

To come to the question of the conferences themselves, a matter to which I have given a great deal of thought. We have had considerable experience in South Africa of conferences because, not only have we many Governments falling within the Union, but we have to deal with foreign Governments; fortunately they are now reduced in number. I feel that we should have conferences of three descriptions:—

(1) Pan-Empire Conferences similar to this, to meet at intervals of, I should think, not less than three nor more than five years. There is one point in regard to the subject matter to be discussed at these conferences. While a conference in regard to research, the co-ordination of research and the methods to be adopted is, undoubtedly, extremely valuable, we require to exchange our views to the greatest possible extent on the matter of the application of the results of research; in other words, administrative matters. After all, agricultural policy in the various States is largely moulded on the advice of the research officers, the discoveries which they make, and so forth; and the research officers and the administrative officers undoubtedly are *the* people who, apart from fiscal matters, lay down policy for approval of their respective Governments. For that reason I feel it is desirable that at these periodical Conferences the fullest exchange of views on administrative matters should take place.

(2) It is most important, and in this matter the bureaux which have been established or which are proposed to be established should play the leading part, that there should be conferences of research workers to discuss the purely scientific aspects of their work. I won't venture to say whether those conferences should meet biennially, quinquennially, or at any other period. I think that is a matter which the research workers can best determine for themselves.

(3) Further, and this is a matter which I think is very important, we should have regional conferences to be called together as frequently and at such intervals as circumstances may justify. The matters to be discussed at those regional conferences would be very similar, in my view, to those which would fall to be discussed at the Pan-Empire Conferences. In South Africa questions are perpetually cropping up which require an exchange of views and joint action—I would stress this point—not only of the various parts of the British territories, but very often of adjoining territories, in regard to disease. Insect pests do not respect political boundaries. We have had from time to time during my experience in the Department of Agriculture to arrange joint action in regard to such matters as animal diseases; rinderpest, which is a matter which

will occur to the minds of all those connected with East and South African Colonies; the destruction of locusts, and so forth. The regions would require to be demarcated and the matter of calling these regional conferences together would be arranged by the Governments themselves. It seems to me that this question is so obvious and so important that it requires no further words from myself. I therefore commend these proposals which I put forward, and which are really very simple, to the consideration of the Conference.

Mr. G. G. Auchinleck (Gold Coast): I have very little to say about these periodical conferences except that in March, 1927, the four colonies of West Africa arranged to hold the first West African Agricultural Conference in Nigeria. Unfortunately Gambia was unable to send a representative, but Sierra Leone, the Gold Coast and Nigeria met at the headquarters of the Department of Agriculture in Nigeria for ten days. The conference we held was obviously of the regional type in that we discussed problems concerning the four colonies only. This first West African Agricultural Conference, which now it has been decided will be recurrent every two years for the first cycle, and after that every three years, differed probably from what later conferences will be in that it was very largely an administrative one. We had problems of agricultural policy that had been stumbling blocks in the way of the various Departments for years, and the proceedings of the Conference dealt very largely with those questions. Colonel Williams has mentioned what you might call the effect of the personal contact between officers at these conferences as being possibly the most important part of them, and I think all the officers who were at that Conference will realize that that statement is correct. There are men working out there, very often in the same Department, who had not met for years. Some forty or fifty of us came together; we met each other and learned each other's problems and discovered, to the surprise of most of us, that the problems of Nigeria were very largely the same as the problems of the Gold Coast, Sierra Leone and Gambia. I will not say very much more except that the results of that Conference were so excellent that the four Governments, or three of the Governments, to my certain knowledge, have agreed to carry them on.

Mr. A. Holm (Kenya): Realizing the importance and value of agricultural conferences Kenya convened a conference which was held in Nairobi last year. That conference was, I think, held on the lines of the regional conferences recommended by Colonel Williams. It was a combined conference representing agriculture, cotton, entomology and mycology, and no fewer than ten different countries were represented, and may I here say that we greatly valued the contribution which the Dominion of South Africa made to that conference, likewise the self-governing colony of Southern Rhodesia The conference was also attended by a delegation from the Empire

Cotton Growing Corporation which considerably added strength to its deliberations.

Colonel Williams has referred to the organization of this Conference, and to the importance attached to opportunities being given to scientific officers meeting in conference. With that I entirely agree. I suggest to the Conference there is also a value attached to holding conferences where scientific officers have an opportunity of meeting administrative officers. I think the way that conference in East Africa was organized was of value in this, that while there were sectional meetings of the scientific officers, opportunities were given both during and at the end of the conference for meetings between the scientific officers and the administrative officers so that each might understand the other's point of view and thrash out their difficulties.

Our experience was that the conference involved an enormous amount of secretarial work. Now, it is true that we had the advantage of having behind us what was called the Conference Secretariat for East Africa, but ordinarily a colony is not so favourably placed. If the value of the Conference is going to be real, the work done at the Conference and the recommendations made by the Conference have got to be followed up. These conferences bring about an enormous aftermath of work, and unless the deliberations are followed up properly by administrative and secretarial action I fear the value of them will be very largely lost.

I would mention again, no doubt some of the veterinary officers will refer to it, that veterinary conferences have also been held in Africa, the Pan-African Veterinary Conferences. Two to my knowledge have been held during the past decade or so, and arrangements are being made for another to be held next year. I notice in the useful memorandum submitted by the Gold Coast on this question the suggestion that five countries in East Africa should be grouped together for the purpose of a conference. Rightly or wrongly, we worked a good deal further than that in regard to the conference already held in East Africa and we brought within its orbit the Union of South Africa, Southern Rhodesia, and two or three of the territories under the administration of foreign Governments. I think we were right in that action, and I hope that will be continued in the future in regard to any similar conference. As has been said, scientific work, the protection of the agricultural industry against the spread of disease of plants, knows no geographical boundaries.

In conclusion I would just say that, while the value of the work of such conferences as have been held in East Africa may not be very apparent to those who did not attend, I think I am correct in saying that each one of the thirty odd officers who attended that conference felt that they were returning to their own Departments of Agriculture more efficient officers than they were before they came to Kenya.

CHAIRMAN: I am going to venture, gentlemen, to take rather an unusual course in view of the importance and the general interest to all of us of what I think Colonel Williams has called Pan-Empire Conferences. There seems to be a general feeling that these conferences ought to be held at not too long intervals, and that the most suitable interval would be a quinquennial one. I am wondering whether we cannot settle this question off-hand with the full authority of the Conference assembled in plenary session, and I am going to venture to move from the Chair, with the authority such a motion may possibly have, that what is called a Pan-Empire Conference similar to this be held quinquennially, and that the next conference take place five years hence. If there is any substantial criticism of, or opposition to, this proposal we shall have to refer it to the Administrative Commission. I think, however, we have made a very promising start with the present Conference, and I should like to get now, if possible, the unanimous approval of this Conference to that motion. I do not want myself to indicate what the venue or location of the next conference shall be.

MR. G. A. JULIUS (Australia): We have been here for three days, and I do not think anyone of us can have failed to have been impressed immensely by the enormous value of a conference such as this. If we do no more than we have already done I think it may be said to have been worth the while of those who have come long distances to have attended the Conference. It is of particular value I think to those who have come from the very far distant parts of the Empire, such as South Africa and particularly Australia and New Zealand.

So strongly does the Commonwealth Government recognize the value of the contact which is afforded between scientific workers and administrators in agricultural science by these conferences that I have received a cable from my Prime Minister, Mr. Bruce, instructing me cordially to invite this Conference, should it decide to hold periodic Empire Conferences, to hold the next one in Australia. To a conference there, delegates from the various parts of the Empire would be most cordially welcomed by the Federal Government. In 1914 a Scientific Congress was held in Australia. I believe that Congress did afford much of interest to the many visitors who were able to attend from the various parts of the Empire, while it did an enormous amount of service to science in Australia. I know that New Zealand will agree when I say that our workers from their situation in these far distant parts are starved for want of contact with their brother workers in other parts of the world. I have very much pleasure indeed in seconding the resolution proposed by the Chairman that these conferences be held at intervals of five years, and I am to add to that Australia's very cordial invitation to hold the next conference in Australia.

DR. C. J. REAKES (New Zealand): Speaking as a delegate from New Zealand I should like to say that I most heartily approve of

your motion, and I most cordially support the proposal put forward by Mr. Julius that the next conference should be held in Australia. We feel, as Mr. Julius has stated, that we are a long way from the main centres of scientific activity, but at the same time we are very keen and very anxious to further and to increase the volume of our scientific work, and we should most highly appreciate the attendance at our end of the world of our colleagues and fellow workers throughout the other parts of the Empire. I most cordially support the proposal.

Dr. J. H. Grisdale (Canada): I am most heartily in favour of the holding of these conferences, and I think the quinquennial period is about as good a one as we could fix upon. The deliberations of the Conference up to the present moment have been very interesting, and I think of great advantage to the countries participating. The very fact that we are getting friendly with each other; that representatives from the different countries are meeting here discussing, not in public always, their activities and their work, and learning to know each other, is of inestimable value alone; therefore, I quite agree with Mr. Julius that these conferences are well worth while, even should nothing more be done than holding these plenary sessions. As to where the next conference should be held, I am quite in accord with the affirmed sense of the meeting that it would be well to hold these conferences in different countries. Australia is a long way off, but really I know there are a number of delegates who would be delighted to visit Australia and, in view of the fact that we ought to know something of the different parts of the Empire as well as our own country and Great Britain, I am in accord with the suggestion of Mr. Julius, acting on the invitation from his Prime Minister, Mr. Bruce, that the next conference be held in Australia.

Chairman: Unless there is anyone else who would like to express an opinion on this proposal I propose now putting it to the Conference.

(*Carried unanimously.*)

I take it, therefore, that I have the authority of this Conference assembled in plenary session to accept with gratitude the hospitable invitation of the Prime Minister of Australia to hold the next conference in that country.

(*Carried unanimously.*)

[Note.—At a subsequent plenary session (on October 27th) the Chairman read the following letter from Sir James Parr, the High Commissioner for New Zealand:—

"Dear Lord Bledisloe: It gave me great pleasure to hear from Dr. Reakes of the decision arrived at by the Imperial

Agricultural Research Conference, on the 7th instant, to accept the cordial invitation of the Prime Minister of the Commonwealth of Australia to hold the next conference, five years hence, in Australia.

"I advised my Government of this, and am now in receipt of a cabled message from my Prime Minister, Mr. Coates, requesting me to extend a cordial invitation to all those delegates who attend the next conference to afterwards visit New Zealand, where they will receive a hearty welcome.

"Apart from this, Mr. Coates advised that the New Zealand Government will in due course communicate with the Government of the Commonwealth of Australia with a view to doing anything it can to assist in making the conference in every way valuable and successful."]

Mr. Ormsby-Gore (Colonial Office): As you have heard from Mr. Auchinleck and Mr. Holm, the Colonial Dependent Empire as also the Union of South Africa have set examples in the holding of extremely valuable regional conferences. I am entirely in agreement with those who have spoken, that the two recent ones in East and West Africa have been of immense assistance. The same practice has obtained in the West Indian group of dependencies in the past and also with extremely beneficial results, but so far there has not been in the Empire an agricultural conference in what one may call the Indian Ocean Far Eastern Group, and it certainly occurs to me, as representative of the Colonial Office, that it would be a great thing if some time before the next Pan-Empire Conference it would be possible to arrange for a Far Eastern Conference in which not merely the chain of Colonial dependencies in the Far East, but also the great Empire of India could take part. The notable constituents of a conference of that kind obviously would have to be India, Ceylon, British Malaya, the Borneo States, possibly the mandated territories of Australia and the Pacific Islands. I believe that if such a Conference could be organized, say in Singapore, and could enter into communication with our Dutch neighbours there, so that the conference could not only enable workers in India, Ceylon, Malaya and those adjacent countries to meet, but also to pay a visit to Buitenzorg at the same time, we should really be advancing the cause of Tropical and Sub-Tropical science as few regional conferences would be able to do, and providing material for the workers for the next quinquennial Empire Conference in Australia. I only throw that out as a suggestion that might be present in the minds of delegates from the countries I have alluded to. I realize it is quite a new suggestion.

Mr. Holm alluded to the value that was given to the East African Conferences by the presence of representatives of the Empire Cotton Growing Corporation, &c., as well as administrative and technical

officers from the neighbouring group of territories, and I certainly think that when these regional conferences are held it is probably a good thing if one or two people from outside the region of recognized authority could be enabled to attend. I particularly refer in this matter to the probable development arising out of this Conference of the bureau system, that is to say, it would be very fortunate if at any regional conference opportunities were given and invitations issued to some representative, not necessarily the head, of the Bureau, but one of his staff, to attend to enable contact to be maintained between regional workers and the central bureau.

I am sure delegates from overseas are very glad to see something of the work that goes on in the Universities and the Institutes of Great Britain, but I do believe that it is of immense value to the scientific workers in the Institutes of Great Britain to go overseas, and still further than that I am quite sure that the more workers in any particular field can see their problems as they face workers under slightly different conditions, the more forward we shall get. In this connection I have in mind the extracrdinarily valuable report we have received from Dr. du Toit, as a result of only three weeks' visit to Nigeria. I think that visit was of immense help to Nigeria, and certainly I believe it was of help to him, and one feels that regional conferences afford a unique means of movement of personnel from one part of the Empire to another which gives a general stimulus and encouragement to workers in this great common field.

Dr. F. J. F. Shaw (India) : I value very greatly the expression of the opinion of this Conference on the importance of periodical conferences. In India we have biennial meetings of the Board of Agriculture. The Board of Agriculture consists of agricultural and veterinary officers from the different Departments of Agriculture in India and also of representatives from non-official scientific departments, such as the Scientific Department of the Indian Tea Association. The Board of Agriculture meets either at Pusa or at the headquarters of one of the Provincial Departments. It deals principally with administrative questions, and as its meetings have not always met the needs of the specialist officers of the departments we started some years ago what we called sectional meetings of the Board of Agriculture. These sectional meetings consisted of gatherings of the workers in any particular branch of agricultural science. Mycology has had three meetings ; entomology has had many meetings, and chemistry has had some meetings. Unfortunately when the axe of economy fell in India these sectional meetings were discontinued. I considered them of very great importance because while our Agricultural Departments are organized upon the basis of the existing political boundaries of Provinces, the agricultural problems with which we are faced are not, as has been already pointed out to this Conference, limited in the same way, and if we, as research workers, are to make common contact on these problems

we must have opportunities of meeting and discussing them together. I do not think that any amount of correspondence between research workers can ever replace the personal contact.

I personally welcome the suggestion of Mr. Ormsby Gore that India should take part in a regional Far East Conference. I am sure the suggestion will appeal to all workers in the various Agricultural Departments in India. I cannot, of course, give it the official blessing of my Government, but I am in very great sympathy with it myself, and I am sure everyone else in the Agricultural Departments in India will be also.

Sir Daniel Hall: I think it should be borne in mind when the Conference is considering periodic conferences on technical subjects that there exists in many of these cases an international organization which holds periodic conferences. Now, as these scientific subjects are international and world-wide, it is eminently desirable that any Empire conference should try to join forces with the international one. You cannot afford to be left out. For instance, there has been during this past year an important conference of Soil Workers in the United States; again the first meeting of the Genetic Conference since the War has been held this last month in Berlin. Men working in those subjects in the Empire want access to such conferences and an opportunity of meeting the leaders to whatever nation they belong. Therefore, I would suggest when this subject comes to be discussed by the Administrative Commission that we bear these international conferences in mind and see if the Empire specialist meetings cannot coincide with them, and perhaps be held some time just before or just after the international conference.

Chairman: It occurs to me that in order a little to clear the air, putting aside for the moment what is called the Pan-Empire Conference like this which we have already dealt with, there would appear to be two different types of periodical conference. There is what has been described as the regional conference, which I take it might deal with more than one technical subject. On the other hand you have your technical one-subject conference consisting of mycologists, or entomologists, or persons interested in animal husbandry or nutrition and so on. I rather imagine that if you are going to set up bureaux dealing with other subjects than mycology and entomology on an Imperial scale, those bureaux will do what the existing bureaux do, arrange to have quinquennial or other periodical conferences in respect of their particular subject, and if that is so perhaps we could leave it to the bureaux, when formed, to settle whether there shall be such periodical conferences, and at what intervals. If that is the view of the Conference the remaining subject that requires further discussion, apart from what the Administrative Commission will give to it, seems to be limited to this question of regional conferences.

Mr. A. H. Kirby (Tanganyika): I should like, with your permission, to put before members another type of conference, small but very important. The work and policy of research institutions must, of course, be guided absolutely by the needs of the areas which they serve; also the work of the agricultural departments, especially experimental work, will be guided by the needs of those research institutions. This means that from time to time the administrative side of the agricultural departments will have to meet the experts and the chiefs of the research departments in order that, by commencing with conference, they may co-operate. That is of the very greatest importance and the work of the agricultural departments on experimental lines will have very largely to depend upon what has been decided at these conferences. It may be argued that the matter is a domestic affair, but I do not think so altogether because for holding these conferences resources are required, and we are not always sure of the amount of local sympathy we want when we ask for those resources. We think if this Conference took definite notice of smaller conferences of that kind it would be of the greatest assistance to us locally, while on the other hand any neglect or omission to do so would rather add to our difficulties.

Chairman: This valuable suggestion of Mr. Kirby's is, I think, raised in a paragraph in the unclassified memoranda on administrative subjects. I am sure the Commission will bear carefully in mind what he has said.

Mr. W. G. Freeman (Trinidad): I should like to quote from our experience in the West Indies as to the real value of these regional conferences which have been suggested. Regional conferences of this type have taken place in the West Indies since, I think, about 1899, about the first year after the old Imperial Department of Agriculture was started. They were held at first fairly regularly, and administrative officers and planters in the whole of that group of colonies came into touch not only with the agricultural, but also with the educational officers, because their work overlaps in the smaller colonies such as these.

The point made by Mr. Ormsby-Gore that regional conferences such as these would be a valuable meeting ground for representatives from home has also come into effect. As regards our last two conferences, one in 1912 held in Trinidad, and the second, owing to the break caused by the War, not until 1924, Dr. Hill, of Kew, was present at both, the Bureau of Entomology was represented at both (at the first by Dr. Marshall), and the Bureau of Mycology was represented at the second. At the second we also had the advantage of the presence of Sir Arthur Shipley, who came to us at that time, and took part in the laying of the foundation stone of the Imperial College of Tropical Agriculture. So that these regional conferences, if organized on a proper basis, not only supply

a means of bringing about co-operation between the workers and the administrative officers in those regions, but they also attract the senior scientific people from home with whom we also want to get into personal touch.

Major R. G. Archibald (Sudan) : I should like to take this opportunity of supporting all that Colonel Williams has said with reference to the value of regional conferences. As a member of the Sudan Government I feel that we occupy a somewhat isolated position, chiefly owing to our geographical situation, but I also feel that, although isolated, we have many problems in common, with both Kenya and West Africa. On behalf of research workers and the Sudan Government, therefore, I feel certain that we would welcome any invitation to a regional conference, either in Kenya or West Africa.

8.—Unclassified Administrative Subjects.

Friday, October 7th, 1927.

Dr. C. J. Reakes (New Zealand) : The views held by New Zealand are expressed in the memorandum* which has been circulated to the delegates, and I really need add very little to what has been said there. We in New Zealand find that in order to obtain the very best results from our agricultural and pastoral industries it is essential to have the closest co-operation existing throughout between the research workers and the officers doing what one may call routine laboratory work, and the instructional officers in the field.

Perhaps I might be pardoned for taking up the time of the Conference by referring very briefly to the system which we have in operation in New Zealand. We are essentially, as you are aware, a pastoral country, though with a certain amount of arable farming going on as well. For many years past we have, by a system of inspection, aimed at keeping animal and plant disease under control and eradicating it where possible, and generally maintaining our industry in the best possible position from that point of view. It was found that many farmers resented the appearance of inspectors on their farms, and it was very quickly realized that instruction, if properly carried out and properly followed, was a most valuable factor in bringing about the object at which we were aiming, namely, the maintenance of our animals and crops in a sound condition and free from disease. A system of instruction sprang up, and we now have instructors in agriculture who also deal with pastures and all the phases of pastoral farming, we have instructors in dairying, instructors in animal hygiene and nutrition, and, generally speaking, officers who deal with all phases of rural industries, including, what is very important to us, the fruit industry. These officers are

* Appendix C, p. 235.

continually coming into touch with plant disease, animal disease, and so on, and by utilizing the facilities offered by the various laboratories we have established, they are able to get specimens identified, to get information direct from the laboratory workers, and are thereby placed in a position to give the farmer or the fruit grower or the dairy factory manager, as the case may be, the best possible advice as to how to overcome his difficulties.

Apart from what I might term the routine work, we are endeavouring, so far as our man-power permits, to do fundamental research work, and it is in connection with that particularly, perhaps, that the value of the association of the travelling instructor or even the inspector with the research worker is most strongly emphasized. These men, as the result of moving about the country amongst farmers, fruit growers, bee-keepers and others, are in a position to observe closely all the conditions bearing on the particular outbreak of disease or particular difficulty in obtaining the crop which the farmer hopes to obtain, and to draw their own general conclusions as to the factors operating to cause trouble. By conveying their ideas to research workers the latter are placed in a better position to think out the particular lines along which they will continue their work, and we have found it to be of the very greatest advantage to maintain that close association between the field workers and the research workers and others engaged in work in our laboratories. I have been very much impressed by that, and thought it worth while expressing in a few brief sentences the views we hold in that respect.

Mr. A. H. Kirby (Tanganyika Territory) : As I am responsible for three of the memoranda I should like to say a word or two connected with them. They will be found to deal with one or two matters that were brought up in the discussion on the difficulties that are sometimes found where a research station already exists. If members of the Conference wish me to elucidate any matters in these memoranda that may not be quite plain I will do so.

Colonel G. N. Williams (South Africa) : I think it is quite unnecessary for me to elaborate the points made in the memorandum by South Africa in Agenda Memorandum 6*. The Conference has already, in effect, answered the questions which have been raised.

9.—Work of the Empire Marketing Board.

Friday, October 7th, 1927.

Mr. G. A. Julius (Australia) : I would like to raise a matter that may hardly perhaps be regarded as an administrative question, although I think it has some very material bearing. I feel that this session should not end until some reference has been made to the extremely effective work that is being done by the Empire

* Appendix C, p. 235.

Marketing Board. This Conference should not be allowed to close without a very definite reference to the extraordinarily valuable help that His Majesty's Government in this country gave to research throughout the Empire when, a little more than a year ago, it decided to establish the Empire Marketing Board. I believe I am right in saying that at that time it was contemplated, even if there were not definite instructions, that of the funds available to the Board some 15 per cent. should be spent directly in research work, not necessarily in Great Britain, but spread all over the Empire, and from the documents that have been produced I think it is common knowledge that the percentage made available by the Empire Marketing Board is something very, very much greater than the 15 per cent. originally contemplated.

It is unnecessary to refer to the extremely valuable work that the Board is doing in publicity and in assisting outlying portions of the Empire to market their goods in this country. As an example of the publicity work one has only to look at the map at the end of this room—a most interesting example of work done by the Board—and I think that this Conference should convey in some fitting way a very definite expression of recognition of the tremendous service, morally and financially, that the Empire Marketing Board is rendering to various parts of the Empire by the assistance it is giving in the stimulation of research. I have very much pleasure in moving, if I may, that some such reference be made.

Mr. T. Rigg (New Zealand): I have great pleasure in heartily endorsing what Mr. Julius has said in reference to the Empire Marketing Board in promoting agricultural research throughout the Empire. We in New Zealand have greatly benefited by two grants which have been made by the Board, one for an investigation into mineral content of pasture, the other for the biological control of noxious weeds.

The prosecution of both investigations is of great importance to New Zealand. The results which are likely to be obtained will not only be of immense benefit to agriculture in New Zealand, but may have a general application to agriculture in other parts of the Empire.

Dr. J. H. Grisdale (Canada): I feel also that the Conference would certainly be remiss did we not at some time make reference to the work which is being carried on by the Empire Marketing Board. We in Canada have not as yet taken any advantage of the offer of contribution to researches, but I believe that at least one proposition is, or will shortly be, before the Board for carrying on some research work in one of the provinces of the Dominion in conjunction with the Empire Marketing Board. The work proposed should be of very material assistance to Canada as a whole, as well as to the province in which the work would be carried on.

There are a number of other researches, which we think might very fittingly be undertaken, not merely in conjunction with the provinces but with the Federal Government, work which has a very wide import indeed and which would necessitate the co-operation not only of the Empire Marketing Board, but of some of the institutions here in conjunction with the Federal Department of Agriculture. From what I know of the attitude of this august body towards the work, I have no doubt that they will fall in with any sound suggestion that may be made along this line. We feel that possibly we have been just a little slow in Canada in taking advantage of the most generous offer of the Empire Marketing Board in this connection, but Canada is notoriously slow to act in such matters. Once we get under way, however, possibly we shall do something wider than might be expected.

Although it is hardly fitting for me to discuss the lines here, there is one thing which I should like to be allowed to mention. One of the most interesting problems under consideration throughout the world to-day is that of animal nutrition. In conjunction with that fish meal has been found to be of an extraordinary and unanticipated value. Some work has been done in this country and also in Canada, but there seems to be scope for a very material increase in activities in that direction, and that is a field in which I feel the Empire Marketing Board might enter and co-operate with the Instititions in this country, with the Federal Government, let us say, in Canada, possibly with the Federal Government in Australia, and with some of the companies or organizations interested in fish and fish products in those countries. We discussed this at some length with Dr. Orr the other day, and felt that it is really possible to undertake something in this connection.

There are other fields, too, which I need not mention at this time, but I do want to add my appreciation of the willingness of the Empire Marketing Board to co-operate, and also to take broad views in these matters, not confining themselves merely to marketing or narrow problems as they might be called, but taking as broad an outlook as one could well imagine or desire.

I, therefore, have much pleasure in associating myself with the expressions of congratulation voiced by Mr. Julius and seconded by Mr. Rigg.

Colonel G. N. Williams (South Africa): I wish to associate the Union of South Africa thoroughly with all that has fallen from the previous speakers. The work of the Empire Marketing Board is, in my opinion, entitled to appreciation. After all, the bond of Imperial unity rests on the material prosperity of the various peoples comprising the Empire. While the financial assistance of the Empire Marketing Board is very welcome, and we feel in South Africa it should be devoted to matters of common interest rather than to those of individuals—and that is the basis upon which the Empire Marketing Board is working—we feel the moral value of

the Board far exceeds any financial assistance it is able to give. The Board has a great work to do in the future in drawing together the bonds of unity, and I wish to associate myself (and I feel I am voicing the views of the Government of South Africa) with previous speakers in their appreciation of the work and possibilities of the Empire Marketing Board.

Dr. A. W. Hill (Kew): May I be allowed, as a home official, who benefits by the bounty of the Empire Marketing Board, to say a word? I feel the assistance given to the Royal Botanic Gardens, Kew, to enable the senior member of the staff to visit overseas parts of the Empire is of very far-reaching importance. I might also add, being a Governor of the College of Trinidad and being associated with the Secretary of State in regard to Amani, that the help contemplated and being given to those research stations is also of far-reaching value to the Empire generally.

Major G. N. Blackshaw (Southern Rhodesia): I am sure that the Southern Rhodesia Government would like me to express on their behalf the appreciation which they have of the work which the Empire Marketing Board is doing. Mr. Amery during his recent visit to that part of the Empire intimated that the Empire Marketing Board would favourably consider rendering assistance to it in one or two very important questions which call for attention in those parts. The work of the Board is bound to have a very important influence in promoting the development of the Empire's agricultural resources.

Chairman: Before putting this resolution to the Conference there are a few matters I should like myself to refer to. I feel in rather an anomalous position as being on the one hand a member of His Majesty's Government in Great Britain and also a member of the Empire Marketing Board, but as Chairman of this Conference I think I ought to mention that the whole cost of this Conference is being borne by the Empire Marketing Board, and in the capacity of your Chairman I think I must, if I can legitimately do so, endorse these expressions of appreciation at any rate so far as the success of this Conference is affected.

I would like to mention a further matter. As particularly responsible for the research and education work of the Ministry of Agriculture in England and Wales, I should like to say that the financial support of the Empire Marketing Board has given an immense stimulus to the work of all our agricultural research stations throughout this country, and has rendered it possible for them to extend their activities beyond the confines of this country so as to be of Imperial value and importance. I put it to you that this resolution be adopted by this Conference.

(Carried unanimously.)

Mr. Ormsby-Gore : In the absence of Mr. Amery I should like to express his thanks and the thanks of His Majesty's Government in Great Britain who initiated the Empire Marketing Board quite recently for the expressions of opinion from the representatives of Overseas Governments made this morning in regard to the early work of the Marketing Board. We are only just about a year old, and we have only made a beginning. When considering the problem of improving the marketing and greater consumption in this country of British produce, both grown in Great Britain and in all the Overseas parts of the Empire, we were immediately confronted with the fact that the successful development of such a policy must be based upon ensuring a more regular and higher quality supply of the goods required by the people of this island, and that if we merely attempted to go in for an advertising campaign we should not succeed in bringing that policy to full fruition ; and that the basic work of the Marketing Board must be to encourage, stimulate and help the production throughout the Empire of the highest quality goods.

That means research of all kinds, not merely research and the application of research in the actual growing of the produce and the actual production of the commodities, but in their more efficient transport and distribution. Grants given for basic and other scientific research are now recognized by every thinking person as the most fit and proper expenditure of the money allocated from the funds of the taxpayers of Great Britain, but it is quite clear that we shall need the active co-operation not merely of the agricultural departments, but also of the whole farming community of the Empire if we are to succeed in our major object, and our major object is none other than to stimulate Empire development in its widest sense.

I need say no more except to express my deep gratitude to those from Overseas who have spoken on this resolution, and to assure you that it will be an encouragement to the Empire Marketing Board and their extremely able staff in going on with their work. I trust when the next quinquennial conference meets, that we shall have done a great deal more than we have succeeded in doing in the first 15 or 16 months of work.

10.—Administrative Commission and Specialist Committees.

October 8th to October 26th, 1927.

The Plenary Sessions of the Conference were adjourned from October 8th to October 26th, 1927.

The administrative questions were referred to an Administrative Commission, which, in turn, appointed three Committees to deal with :—

1. Proposed Chain of Tropical and Sub-Tropical Research Stations.

2. Imperial Bureaux, Interchange of Information and Periodical Conferences.
3. Recruitment, Training and Interchange of Workers.

The reports of these Committees were considered and amended by the Administrative Commission on Tuesday and Wednesday, October 25th and 26th, 1927. The report of the Administrative Commission was thereafter brought before the Plenary Conference on Wednesday, October 26th, and approved, after amendment. The report as approved will be found in Part II, Sections 2, 3 and 4, pages 8 to 30.

The specialist questions were referred to Specialist Committees, as already explained in Part I, Section 3, paragraph 19. The reports of these Committees were brought before the Plenary Conference on Thursday, October 27th, and adopted subject to the omission of various paragraphs. The reports as approved and with indications of the paragraphs omitted will be found in Part II, Sections 6 to 17, pages 30 to 58.

11.—General Review of Conference's Work.

Friday, October 28th, 1927.

CHAIRMAN: You will expect from me, as your Chairman, some short summary of the results of our deliberations, so far as I have been able to visualize them, and I propose, with your approval, assembled as we are here on very historic premises which are the home of the Mother of Parliaments, to adopt what I believe for many generations has been, on such occasions as this, the usual Parliamentary practice, namely, to move, at the end of what I have to say: "That this Conference be now adjourned," and having made that motion to invite any of those present who desire to do so to offer any general remarks upon the utility of the Conference, upon the possible realization of its ultimate aims and any suggestions, and this I say with the approval of the representatives of Australia, you may think fit to make with a view to the successful conduct of the next conference to be held five years hence in Australia. We are met here to-day to say good-bye; to wish each other Godspeed, and to express the hope that the seed which has this month been sown in what I think I may call well prepared ground may result in a rich harvest for the great Empire to which we are all proud to belong, and especially for its various agricultural communities.

This Conference has, in my judgment, been a great step forward with a view to the spread of ascertained knowledge to meet the needs of the Empire in relation to its most vital industry. It is, if I may say so, an important landmark in Imperial development, and is, I believe, a harbinger of greater Imperial prosperity. It has been noteworthy for its comprehensively representative character; the eminence, if I may say so, of its personnel, both scientific and administrative; the unfailing high character of its discussions;

the obvious keenness throughout its sittings, and its journeyings; and last, but not least, the unbroken harmony which has characterized its proceedings, and which has smoothed and sweetened them. The Conference has been a big experiment, and I claim for it that it has been an eminently successful one. Its main success, in my humble judgment, has been the mere fact of bringing together distinguished investigators in every branch of agricultural science and able administrators from every part and corner of the Empire, and the pleasant intercourse, friendship, and mutual confidence which have flowed from that simple fact. It may be asked, and no doubt the outside public in every part of the Empire will ask, what, in fact, it has achieved? Apart from the achievements implied in the important fact of its actual meeting, the tangible results may be said to be small, for the very obvious reason that it is not an executive body. It can only advise and recommend, and the carrying out of its recommendations depends, of course, upon the various Governments of the Empire. The majority of its results depend upon the co-operation of the various Governments and their willingness to act upon its recommendations.

What, then, has the Conference done to assist and advise executive Governments? We can point, at any rate, to three main results. In the first place it has surveyed the whole tropical and sub-tropical Empire as a field for agricultural research. It has recommended a scheme of central tropical and sub-tropical research stations. It has defined in general terms the needs which they are to meet; the character of their location and the scope of their work. It has removed some misconceptions as to the place and functions of a central research station in relation to the Government in whose area it is situated. It has made clear its relation to the teaching of agriculture, and it has indicated in a hopeful spirit the sources from which future contributions to central research stations might reasonably be expected. Moreover, it has discussed fully and made recommendations upon what I am sure you will all admit to be two subjects of vital importance to the Empire, namely, the establishment of a central research station in connection with diseases of animals and the further and immediate exploration of the question of a central research station to deal with irrigation.

Secondly, and it is perhaps the most important of all, it has surveyed the question of man power in relation to research. Research, after all, is a matter of individuals, and probably at no conference, no previous conference, has the question how to secure and train the best individuals for research work received more attention, or attention from persons more qualified to speak on the subject. The Conference has indicated the requirements which ought to be looked for in candidates both for specialized work and for posts as agricultural officers. It has fully reviewed the methods of recruitment and the inducements required to obtain efficient agricultural services in the tropical and sub-tropical parts of the

Empire. In particular it has brought out clearly and made suggestions towards meeting the difficulty which arises from the predominance of the physical sciences over the biological sciences in almost, if not all educational institutions. It has similarly reviewed the training required for the Empire as a whole. It has considered and systematized the best opinions on the highly important subjects of study leave and interchange of workers.

It has examined in detail and, indeed, prepared plans for a considerable extension of the existing machinery for co-operation between research workers in different branches of agricultural science all over the Empire. It has by no means confined itself to pious aspirations. It has stated the actual subjects for which further machinery is to be set up, and it has indicated in some detail the nature, the place, and the character of that machinery. Three new bureaux and four correspondence centres will, it is confidently hoped, soon be displaying their vigour as flourishing children of this Conference.

The Conference was called largely to deal with these important administrative problems, but it has not confined itself wholly to their consideration. It would be, of course, utterly impossible to go through all the work which has been done, and most admirably done, and the recommendations which have been made by the various specialist committees. Many of those are covered by the administrative measures which the Conference has recommended. It is perhaps sufficient to say that practically every branch of agricultural science has been surveyed by those who are most familiar with it. Any gaps left in the provision now made have been indicated and recommendations have been made to fill them. One or two examples perhaps I may be allowed to give.

In plant pathology the Conference has drawn attention to the great importance of virus diseases in plants, and has made proposals for a more extended study of the fundamental nature of those diseases. It has pointed out the great importance of insecticides and fungicides in the control of diseases and pests, and has asked for an investigation of the whole chemical field by chemists working in collaboration with entomologists and plant pathologists. It has defined various important questions which urgently need scientific research, and the Conference, through its Veterinary Committee, has surveyed not only many purely technical or local problems in animal diseases, but also not a few which are common to practically all parts of the Empire, such as the elimination of tuberculosis and the methods of control and diagnosis of contagious abortion; and last, but not least, it has possibly for the first time endeavoured to make clear the value and vital importance of the study of agricultural economics.

Of course the results which are embodied in the Reports adopted by the Conference are very far from being all that the Conference has achieved. One result we in this country hope has followed—

and it will be peculiarly gratifying to us if that hope is fulfilled —is that the research workers from overseas have been afforded a chance, at the cost perhaps of a somewhat strenuous life, of seeing something of a good many of our research men and research stations in Great Britain and Northern Ireland. We hope that they are convinced that the research done there and the facilities which are afforded to the workers, both resident in this country and in other parts of the Empire, are such as to induce an ever-increasing flow of men coming here to learn and refresh themselves and also to instruct our own workers, just as we here realize the value and importance to a man habitually resident here of a visit, long or short, to another part of the Empire.

May I venture to say that, in my opinion, we have, as a result of this Conference, reached important decisions with an imposing measure of unanimity. We may, however, establish bureaux and chains of research stations, and we may train and exchange research workers, but without mutual confidence and the determination to co-operate which it engenders our task would be in vain. The ultimate results of this Conference it is impossible to visualize and, in all their potentialities it would need a man of extraordinary courage and hypermetropic vision to prophesy the final dimensions of the new structure of which we have this month laid the foundation stone. At least that stone has, in my judgment, been well and truly laid. I have the temerity to believe that there has been no Conference of an Imperial character which has been more harmonious, more definite in its objectives, or more constructive in its deliberations and decisions ; or, if I may be allowed to suggest it, more calculated in its results, not only to contribute to the ever-growing solidarity of the Empire, but materially to affect its future prosperity and happiness.

Agriculture we must remember is far the largest industry of the Empire, and for many generations yet will continue to be so. Upon its enhanced productivity as the result of the prudent application of science depends the well-being, the happiness and the contentment of the vast populations of that great commonwealth of nations to which we are all so proud to belong. On the 4th October we met as strangers. To-day we part, I think I may be allowed to say, as firm friends. May that friendship continue to grow for our mutual advantage!

You have thought fit to select as your new central scientific bureaux and correspondence centres certain research stations in this, the old country. Let me say on behalf of those stations that, in no insular or selfish spirit, we accept the Imperial trust which such selection involves and we shall endeavour to justify your confidence by the faithful discharge of our fiduciary obligations. The keen interest which our overseas colleagues have displayed in our own centres of agricultural research (and some of the most important of them still remain to be visited) has kindled the zeal

of our British workers and our British administrators and has inspired us with fresh ideals and fresh determination to work earnestly in the cause of Empire development.

It is perhaps, gentlemen, a little unfortunate that your visit has synchronized with a very exceptional, perhaps unprecedented, depression in agriculture in Great Britain, but I would like to say in that connection that, having worked in the field of agriculture both, perhaps for my sins, as a farmer and also in an administrative capacity for many years, I have a growing conviction that the fortunes of British agriculture lie very largely in the direction of realizing the Empire rather than this nation as the agricultural unit and the consciousness that by co-operation with due delimitation of our respective spheres with fellow agriculturists in other parts of the Empire there may be in store, even for British farmers, a larger measure of economic prosperity in the future.

We say good-bye to you, our overseas friends, with very deep regret, but the retrospect of our pleasant intercourse will always be happy and the prospect of its revival will be a stimulus in the pursuit of our daily avocations wherever they may be. The next Conference is destined to take place in Australia five years hence on the cordial and much appreciated invitation of the Prime Minister of that great overseas Dominion. We are especially glad to learn, by the message from the High Commissioner of New Zealand yesterday, that New Zealand is prepared to co-operate in making the Australian Conference a real success and has offered hospitality after the Conference to those delegates who are prepared to visit that beautiful and interesting part of the Empire. The last words I want to say are these. I do most confidently hope that we shall all do what is in our power to make the next Conference at least as great a success as this Conference has been. I realize—no-one can fail to realize—that there may be some attractiveness to those who work in distant parts of the Empire to visit the old country from time to time, and to arrange their holidays, or leave, accordingly; but I do venture to hope not only that we who live and work in the old country will do our very utmost to get out to Australia and support the Australian Conference five years hence, but also that those who come from other parts of the Empire will do their very utmost and make up their minds now to set apart if they can a period for the Conference five years hence to visit Australia and to co-operate in making that occasion a big success.

With much regret I beg to move "That this Conference be now adjourned."

Mr. G. A. Julius (Australia): You, Sir, have set a very difficult task to those of us who have the honour to follow you. You have made a marvellously clear and rapid review of the work that has been done at this Conference and of the results that may be expected to accrue from it. We in Australia realize—at least perhaps I should say the delegates here present are beginning to understand

very clearly—the magnitude of the task before us to make the Conference to be held in Australia five years hence worthy of the precedent that has been established by this Conference. We will spare no effort to get all the advice we can to help us.

We feel, for instance, that, great and successful as this Conference has been, there may be some here who have thought out ways in which even greater progress might have been made, even more and fuller work done, and we want to get those suggestions whilst they are alive in the minds of those who have attended our meetings during the past month. We feel also that, during the five years that must elapse before the holding of the next Conference in Australia, various other ideas may suggest themselves to those present or to others who propose to attend the next Conference, ideas of which Australia wants to get the benefit. May I suggest, therefore, that delegates here assembled should take the opportunity, this morning, to give such advice as they are able in regard to the conduct of the Australian Conference? It has been suggested that it might even be desirable to set up a Committee to operate between now and then, but I think the time is hardly ripe for such action. I do, however, feel that some very definite form of liaison should be established between this Conference and the next, and I suggest, Sir, that it would be extraordinarily helpful if the Ministry of Agriculture could arrange to receive and record the suggestions made at this Conference and made subsequently during the next five years, so that they would be available for use to the greatest advantage when we have in hand the organization of the later Conference.

I can scarcely express how much I appreciate—and how much Australia appreciates—the very cordial offer of co-operation from the sister Dominion of New Zealand. We feel that, between the two Dominions, we shall be able to show something of real interest to agricultural research workers from the various parts of the Empire.

I have a feeling that in this country—I speak entirely as a layman and without making any claim to a special knowledge of agriculture—it must be very difficult and somewhat unusual for the research worker to experience the stimulus of outstanding success in the effecting of some material improvement in the efficiency of agriculture. The research worker is very human—or so I suspect him to be—and, in a country where the standard of agriculture is, relatively, so high and has been so long established, he must at times miss this stimulus. There is no such fear in those great areas of the Empire overseas—areas largely unpopulated—in which the problems are legion and in which, in comparison with this country, agricultural efficiency is low.

I do hope that, as one result of this Conference, a steady stream of young and competent men will set in, men trained in the great centres in this country to take up work, their life work, in these

great overseas centres ; indeed there is a very great field awaiting them.

May I say, Sir, that Australia desires very warmly to congratulate the Imperial Government on having taken the initiative in summoning this Conference. The action which has been taken must be, indeed is, heartily appreciated in all parts of the British Empire. It seems to me that the action was wise, not only from the point of view of Empire agriculture, but also from the even wider point of view of Empire trade as a whole, and not least of the trade of Great Britain herself. British industry and British commerce can have no more important an objective than prosperous agricultural conditions in Great Britain itself, in the great Dominions, in India, and in the Colonies, for it is the primary producers in these countries who are the largest purchasers of the products of British industry.

Dr. J. H. Grisdale (Canada) : After the very exhaustive and enlightening way in which our Chairman has dealt with the activities of this Conference and the results achieved, or that it is hoped may have been achieved, there seems very little for me to say. I would like, however, to make a few remarks as to what we, as Canadians, consider to have been the most striking features, the most important achievements and the best results that may be expected to accrue to us from this Conference.

When the question was first mooted just about two years ago and we got the notice in Canada, that notice was laid on the table for an indefinite period during a political upheaval which lasted for about a year, and it was not until September, 1926, that the matter was given much consideration, but at the last moment it was decided to send a delegate from Canada to take part in the deliberations into research that were to constitute a part of the Imperial Conference last Fall. There we thrashed this matter out fairly fully ; holding conferences every day for about three weeks, and the thing began to take form. I, for one, went back to Canada enthused with the idea that something tangible was in the air, something that might result in great advantage to Canada and to the Empire as a whole. I began to talk the matter up and found willing listeners in our Dominion, with the result that we have with us to-day and have had during this Conference seven representatives from Canada. This was looked upon by the authorities in Canada as rather a strong delegation, numerically, but nevertheless they agreed to it feeling that it was an exceedingly important Conference and one in which Canada should be well represented.

Our anticipations have been more than realized. We are delighted indeed that we came. We are gratified with the progress made, and we anticipate most excellent results. I want to mention specifically two or three features that we consider of primary importance.

To begin with the bureaux. As I have indicated, I think on one or two previous occasions at this Conference, the bureau is why we are here. These bureaux seem to me to be the centres in the future in the way of making progress as an Empire, as a unit in agriculture, and in research generally. We can scarcely over-estimate the benefits that we are certain will accrue from the establishment of a liaison between the workers in Great Britain, the Dominions, India and the Colonies. I have met, to my great advantage, to my pleasure, and to my satisfaction many of the workers who are here with us to-day. Their faces are exceedingly familiar. I am sorry I cannot call them all by name when I meet them, but I want to say that by every man to whom I have had the opportunity of speaking the same views have been expressed. The advantages of this opportunity of meeting and discussing subjects of importance to us, of becoming known each to the other, establishing confidence in our dependability, our earnestness and our reliability, because that is an exceedingly important matter, can scarcely be over-estimated ; they are certain to be tremendous.

We in Canada, the whole delegation, will go back feeling very much broader and very much more capable officers than ever before just because of this connection, these acquaintances that have been formed, these friendships that have been established and this realization of the breadth and possibilities for co-operation in research and progress throughout the Empire.

As you know, we in Canada are situated somewhat differently from any other Dominion or any other part of the Empire. We are so closely connected, so closely allied, in spite of all we can do, with the great Republic immediately to the south of us that it requires a tremendous amount of energy and independence and initiative on our part to remain a separate unit. I mean in research. Consequently any establishing of connections, any opportunity of getting in touch with the Empire research agriculturists like this is of untold advantage to us ; it establishes a feeling of closer connection with the Empire that is of inestimable value.

I want to mention two or three other features that hold out great possibilities for us and for the Empire as well. I believe these talks we have had about the exchange of workers are of very great importance indeed. We in Canada feel that our research men have got into a certain groove, a certain line of work, on account of that proximity to the Republic to the south of us, and that we are inclined to try to spread over too much, to cover too much ground, instead of concentrating on a few lines. Our experience here, our visits here, have demonstrated to us the need for more concentration, for deeper investigation, and for more thorough work in every way. Now, if we can get, through this medium of exchange which it is hoped will be established, our men better trained and men from other parts of the Empire imbued with the same ideas, then Canada will have reaped a tremendous advantage in this way.

As to the quinquennial conference to be held in the country of my esteemed friend opposite, Canada hopes to be represented. I will not say we can send seven or eight men, but we will send some, and I am sure that Canada will try to take as great an interest in that conference as in this one.

It remains only to say how much we regret to break up this Conference. Our labours have been strenuous ; sometimes we did not know just what we had better do next ; there were so many things to do. We could not tell what things to see ; there were infinitely more than we could possibly see. As I have said before, we had almost mental indigestion from the superfluity of subjects for consideration, of things to see, people to meet, ideas to grasp and engagements to keep. That, added to the consumption of food which has so characterized our peregrinations as well as our permanent residence in this city, has united to tire us almost to the point of exhaustion. However, we have enjoyed every minute of it. We only wish we could have a day or two's rest and then get at it again. That, fortunately for you people, is impossible, because I can imagine how tired you, Mr. Chairman, and your confrères must be. I have had experience of such functions at Ottawa and know how they go. We regret very much to take our leave. We have enjoyed our sojourn in your hospitable city, and your hospitable country, and only hope that we can come back again. I, therefore, say that we hope to meet many of you in Australia in five years and possibly some of you before then.

Dr. F. J. F. Shaw (India) : I would add my voice to that of the representatives of Canada and Australia in expressing regret at the termination of this Conference and my appreciation of the results which it has achieved. As you are aware, research in Indian agriculture is at present undergoing re-organization, and this fact has perhaps prevented India's representatives from speaking at this Conference with that definiteness and weight which India's position in the Empire would warrant and her dependence on agriculture demand.

In no other part of the Empire are so many of His Majesty's subjects so directly dependent upon agriculture as in India, and I feel that nowhere else can the applications of science to agriculture and the complete realization of the principles approved by the Conference confer such lasting benefit. I would assure the Conference that the reports of which we have approved will be considered by the Government of India in a spirit of sympathy and with an earnest desire to co-operate with the other Governments of the Empire in any steps which we can take for the material prosperity of our Empire as a whole.

If I were asked what has been the thing which has impressed me most in this Conference I should say it has been the sense of our mutual dependence one upon another in furthering the cause of agricultural research. I have learned in this Conference that in

the great Dominion of Australia some of the best and most productive wheats which are grown have been bred from wheats of Indian origin. I am sure that many other instances of this kind will occur to you, and I think that our sense of mutual dependence one upon another has been greatly strengthened by the personal contact which we have had at this Conference.

With regard to the subjects which we have considered, India is equally interested with the great Dominions and Colonies in the development of the bureaux system and of correspondence centres. If I had to pick out one particular bureau of the new bureaux which have been proposed which is I think more important than any other to India, I should select that of animal health. There are two other subjects which perhaps concern India more closely than they do the Dominions. I refer particularly to the chain of Empire research stations in the tropical and sub-tropical parts of the Colonial Empire. India stretches from very nearly the latitude of Gibraltar to very close to the Equator, and in that vast area we realize almost every condition of soil and climate from the desert conditions of the Sudan to the tropical forests of Malay. I feel that no chain of research stations could be complete without India playing a part in it. The other matter is that of a regional conference of agricultural workers in the Far East. Here again no conference could be adequate without the representation of the largest and most densely populated of His Majesty's Dominions in the East. When we come to meet again in five years' time in Australia I trust that the relative proximity of Australia to India will enable the country which I represent to take part in that gathering.

Colonel G. N. Williams (South Africa) : I really have little to add to what has been so eloquently expressed by the previous speakers, but I feel I could not allow this resolution to be passed without rising to say how we associate ourselves in South Africa with everything that has been said. The matter that has struck me most is that—I think I can best put it in metaphorical language —we all knew that we had a common goal else we would not have come, but we really did not know exactly where that goal was situated, and we all had varying ideas as to the road we should have to traverse. The position of our goal has been correctly orientated and, what is more, the paths by which we can reach it have been clearly pointed out.

In regard to the invitation of Australia, we welcome that in South Africa. We have had admirably exemplified here all the advantages of mutual intercourse, which we have gained by meeting men of mark in Great Britain and Ireland. Now we shall be able to meet other men of Australia who unfortunately have been unable to attend the Conference owing to the vast distance which lies between Australia and Europe. In South Africa, Australia will suit us admirably ; it is easily got at. Therefore, I do not fear that there will be any diminution in the delegation which attends

in Australia. It may be strengthened as regards quality, and I think in regard to quantity it certainly will not fall away.

I wish again to express my thorough association with all that has been said by my colleagues from the Dominions.

Sir Herbert Read (Mauritius): It seems to me quite evident that the members of this Conference have most certainly and most emphatically endorsed your statement, My Lord, that it has been a complete success. I think, however, we should at the same time recognize that a great part of that success has been due to the consummate skill, the unfailing tact and resourcefulness with which you have conducted its proceedings. That, my Lord, applies also to those other gentlemen, Lord Lovat, Mr. Ormsby Gore, Major Elliot and others who have so ably assisted you. I should also like to express, at any rate on my own behalf, and I am certain on behalf of all the rest of the delegation, our profound admiration of the way in which what I may call the staff work, the secretariat work, has been carried out.

Mr. Joseph Chamberlain at the end of his political career, during the course of which he had played many parts in public life and none of them unimportant ones, once said there was nothing to which he looked back with greater satisfaction than the part he had played in encouraging investigation of tropical disease. I venture to think that at some distant date—I am sure we hope a very distant date—Lord Bledisloe will also say there is nothing to which he looks back with greater satisfaction than the part which he has played in promoting the agricultural development of the Empire at large.

So far as the accomplishments of the Conference are concerned, it is scarcely necessary for me to say much after the very comprehensive survey that has been made by our Chairman. Personally, I think that if the Conference had simply brought together from all parts of the Empire the present delegations that in itself would have been a sufficient achievement, but, as has been clear from Lord Bledisloe's speech, much more has been accomplished than that. If I were to pick out, from the point of view of the Colonies, the most important step that in my own judgment has been taken at this Conference, it is the re-affirmation of the proposal made at the Colonial Conference in May that there should be one general research service for all the Crown Colonies with similar emoluments and similar prospects. Hitherto the Colonies have lived more or less in watertight compartments and the result has been that in the less prosperous ones it has been almost impossible to carry out any research work at all. With this new system all that will be changed. I consider that the whole scheme is a most liberal and broadminded one, and I am confident that when put into effect, as I think it must be after the declarations of two successive conferences, the benefits that will flow from it will be simply untold.

As to the future, I have no doubt that we shall gain a great deal

of experience during the coming five years, and I feel certain that at the next conference a further step and a very long step will be taken along the road of progress.

Dr. C. J. Reakes (New Zealand) : As a representative of New Zealand I would like to add a word to what has already been so ably said by Mr. Julius, Dr. Grisdale, Colonel Williams and Sir Herbert Read, and to express my feeling that the results of this Conference will be viewed in New Zealand with the very greatest pleasure. The decisions which have been come to have been very important, and we shall feel that now we are linked up with our fellow workers throughout the Empire to a very much greater degree than we ever were before. I myself and my colleagues, Mr. Rigg and Mr. Grimmett, have appreciated very greatly the opportunities we have had of viewing and getting into personal touch with the work that is being done in this country, and perhaps what is equally important of getting into personal touch with the workers. We have learned a great deal, and we shall go back to New Zealand with our minds refreshed, with our knowledge strengthened and with perhaps an increased keenness to do our part in carrying out this great work of research in agriculture throughout the Empire. I was very greatly pleased to hear the good expression of opinion Sir Herbert Read made concerning yourself, Sir, but I propose to have a special word to say regarding that a little later on, if I may.

Lord Lovat (Dominions Office) : I would only like to make two remarks, and both of them on the subject of the next conference. Mr. Ormsby Gore is in Geneva at the present time, but I have his authority to say that as far as it lies with the Colonial Office we shall do everything possible to assist the next conference in Australia to be the greatest success. I must say that politicians cannot see their way five years ahead, but that will be the feeling of whatever Government or whatever party may be in power.

There is one other point. We in the allied science and art of forestry have taken time by the forelock and have already held two Empire Conferences. After the first Empire Conference we came to exactly the same decision as you have, Mr. Julius, that perhaps a Standing Committee to carry on from one conference to another was not necessary. After our visit to Canada, and on the motion of the Canadian representative, we decided it was necessary to have some sort of permanent link to carry on from one conference to the next. I quite agree it may not be advisable to do it between now and the next conference, but I think then you will probably come to the same decision as we did in forestry. We found in tidying up the ends at the conclusion of the conference and preparing for the next conference there was very much more work to be done than was at first realized, and we had representatives on a Standing Joint Committee first of the Dominion or part of the country in which the last conference was held, and, secondly,

representatives of the country in which the next conference was to be held, and we added to them representatives, not so much from areas as people who were prominent as Chairmen of Committees or others in the previous conference that had been held. We found this work was useful; we found we were able to get at the whole statistical data we required for the following conference, and I do feel the Standing Committee has done successful work. I may remind you this principle was approved at the last Imperial Conference. I do not wish to press that such a Standing Committee should be set up now. I think it is too late to discuss it in all its bearings, but I submit it to you for consideration after the next conference when it meets, and I think it will tend to make other conferences as useful or even more useful than this has been. There is always a likelihood unless there is such a Committee of covering too much ground at a conference. It is exceedingly useful to have some deciding body to speak with authority from the experience of the past, and to express their belief of what will happen in the future.

As far as this country is concerned the Colonial Office will always work in the closest touch, as we have done, with the Department of Agriculture in furthering the cause of agriculture throughout the Empire.

Sir Daniel Hall (Ministry of Agriculture): Perhaps I may be forgiven if I say something about the main ultimate object of this Conference. This is an Empire Conference on research in agriculture. What is our ultimate goal? Clearly enough as things are going in the world at the present time, as countries build their tariff barriers higher, we must try to make ourselves self-supporting in the fundamental and all-important matter of food. We are not self-supporting at the present time, and if we look at our statistics of the imports of food into Great Britain we get a very fair measure of what the Empire as a whole lacks in the way of supporting its own people, because after all most of the Dominions and the Colonies do supply themselves with food. The deficiency is felt here.

When we turn to these statistics we find figures something like the following, which I happen to have with me. We find, for instance, that of wheat and flour Great Britain produces 17 per cent. of her consumption; the Dominions supply us with 43 per cent., and we have to draw 40 per cent. from foreign sources. How are we going to replace that 40 per cent.? I take it that is one of the big problems before us in this task of being self-supporting. The easy extension of area which sufficed in the past is no longer possible; we have got to effect our extension of area by means of research.

Canada has led the way in showing how research, by breeding varieties with an early ripening period, can enormously extend the potential area which can be put under wheat. Australia, again,

has done something, and has still further to go in solving the other problem of how to extend wheat to dry areas by breeding varieties which will throw more and more of their total production into the useful grain and less into the straw. A wheat plant given so much rain can only produce so much stuff. The plant breeder's task is to make that stuff as largely as possible useful grain. South Africa, again, indeed Africa generally, has its problem of getting wheats that will be disease-resistant. We have our own problem here, again a problem of the plant breeder, to produce wheats that will respond under intensive agriculture to high doses of fertilizers, and yet be harvestable even in seasons like that we have been going through. It is by research, and by research alone, that we are going to overcome this deficiency of the wheat supply of the Empire.

Take another great source of food, beef, as regards which the pressure of world demand may first be felt. Great Britain produces 48 per cent. of its beef supply, the Dominions send us 5 per cent., while from foreign sources we draw 47 per cent. There is a great hole to be filled up, and again it has got to be filled up by research. We have our two methods of producing beef. On the one hand it is the product of wide grazing. Well, we know that there are, especially in Africa, great grazing spaces still available, but they are not doing their duty. Sir Arnold Theiler has pointed out why they are not doing their duty, and he has broken into this important field by discovering the deficiency diseases which have been preventing the production of beef in that area.

There is the other side of beef production, the kind of intensive beef production where other products—grains, oil seeds, and so forth—are being used. Here again we need the research, such as Professor Wood is carrying out at Cambridge, to show us how we can economize and use these materials to the greatest possible advantage.

I will only mention one other example of the weak spots in Empire production. Oil seeds are going to take a greater and greater part in feeding the people. Their produce is at the present time, as we know, displacing butter. As far as oil seeds go, we do not produce any here at home, the Dominions and Colonies are supplying us with roughly 40 per cent., but we have 60 per cent. to draw from foreign sources. There is a great opportunity for our tropical and semi-tropical countries, which seem to be most capable under their environmental conditions of producing oil seeds.

Those are the kind of broad conceptions we might have before us in thinking about agricultural research.

There is the other great topic in connection with research, the question of labour. That is the problem before all of us—how to make our population efficient in every sense of the word. We have got to be leaders, we have got to justify our position ; we cannot compete with the black man or with the yellow man in mere weight of numbers, we can only maintain our white standard of life by

ensuring better white men. That requires research into the methods of handling labour, and it requires the education of the individual to make him a human being capable of the very serious task of competing with unlimited cheap labour by skill, intelligence and the use of machinery especially.

We are talking here about research. Here we are in the main administrators, but, as our Chairman has already explained, research is after all a product of the individual. It is a matter of imagination and intuition, in some respects very much like the writing of poetry, and no administrator, no organization, can of itself turn it out. I do want to suggest to all administrators and organizers of research, "Be tender of the research man." He has the defects of his qualities. He has often got many angles, and if you try to define too strictly the exact shape of the hole in which you are going to fit him, he will not go in. We must do everything we can to provide the conditions and the place in which he can give us of his best. We have to work very much by faith in these matters. We are talking about setting up institutions, and we deplore privately to one another the lack of men to put in them. Never mind, let us make the institutions, let us be assured of the future that men will come along, and that such capacities are latent in our nature. It is our pride as Englishmen—if I may use the word collectively for once—that we have got the faculty of imagination which does lead on to discovery and invention. We believe in the future of these institutions because they will provide places of refuge and of stimulus for these men who have got the capacities. For we believe in research. It is our faith. We are building in faith, and we may say with the poet of our building "Seeing that the city is built to music: therefore not built at all: and therefore built for ever."

Sir Robert Greig (Board of Agriculture for Scotland): The Dominions and India, and to some extent the Colonies, have expressed the appreciation which they feel of the benefits which will accrue from this Conference. I would like to place one other aspect of the Conference before you. We do not doubt for a moment that the ultimate results of this Conference will be of great benefit to Great Britain, as an agricultural and industrial unit, but I want the Dominion and Colonial delegates to depart with the conviction that the benefits of this Conference have been fully appreciated by the administrators and researchers in this country. They have spoken themselves of the benefits which they expect will accrue to them. We want to assure them that we are fully aware of the benefits which will accrue to us. I am only the senior delegate of a small and more or less rain-swept but not altogether insignificant country, and I can assure the Conference that my country will benefit extraordinarily from this Conference. We have great interests in the results. We are extremely proud that one bureau and one correspondence centre will find their first home in Scotland, and we are enormously interested in the proposals for the recruitment

and training of workers, because for the last three hundred years the most important export from Scotland has been educated Scotsmen. I speak for my own country, but I think I am speaking for the moment also for England and Wales and the sister island, when I say we want you to realize to the very full that whatever benefits you may have received from this Conference, we have received at least as much; and because I come from north of the Tweed and have had nothing personally to do with the organization of this Conference, I want to add to what Sir Herbert Read has said my tribute to the almost superhuman efficiency of the organization of the meetings of this Conference. We pride ourselves on our power of organization in Scotland, but we must willingly concede that the Ministry of Agriculture officials have shown extraordinary skill and efficiency in the work of this Conference.

We look forward with immense interest to the next Conference in Australia. We hope to be represented there—not in such enormous numbers as Dr. Grisdale has indicated might come from Canada—but at all events we hope to be represented there, and with the experience of this Conference and with an interval of five years in which to get our ideas together with regard to the next Conference, we feel perfectly certain that Australia will fully realize all the expectations which we may entertain.

Professor C. Y. Shephard (Trinidad): The labours of the Conference have almost concluded, the litter is about to be produced, and we are engaged, and rightly so, in the rather exhilarating pastime of patting one another on the back, but I venture to suggest that the value of this Conference will be determined not so much by the way in which it stimulates research and the production of research workers as by the degree to which it succeeds in translating agricultural science into agricultural practice, and I have been appalled, in my short experience in the Tropics, by the enormous gap which does exist between agricultural science and practice. I do not think I am exaggerating when I say that, in general, practice is at least fifty years behind science. Admittedly, in some aspects the agriculturist is perhaps two thousand years ahead of the scientists, but I am perfectly confident that if we could only apply our existing scientific knowledge the output of the Empire could be increased by at least 50 per cent., and at a reduced cost.

I do not think that the agriculturist is entirely to blame for the gap which exists. The scientist, by the premature publication of results, has succeeded in some cases in putting back the clock of development by generations. Fortunately, that type of scientist is dying out. Unfortunately, however, we still have with us the politician and the administrator, and when those gentlemen venture to dabble in technical agricultural problems they succeed not merely in putting back the clock fifty years, but in spoiling the whole works.

I am not concerned with the appalling waste of money, but

I am concerned with the way in which it has retarded sound agricultural development, and I hope that this Conference will succeed in eliminating some of the difficulties with which research workers, particularly in the Tropics, are faced, and I hope that all scientists will endeavour as far as they can to co-operate in reducing that gap which exists between the scientist and the practical agriculturist. In conclusion, may I express the hope that the good Lord and the Empire Marketing Board will preserve us from the enthusiastic amateur.

CHAIRMAN: A suggestion has been thrown out by Mr. Julius in relation to establishing some link between this Conference and the next conference, and I confess I had it in my mind to say something on that subject, but, bearing in mind what Major Elliot has reminded us of, that Governments and politicians are of transient importance, I think perhaps it would be more useful if Sir Charles Thomas, as the Permanent Secretary of the Ministry of Agriculture, and, therefore, of greater continuing vitality, were to say something on this subject.

SIR CHARLES HOWELL THOMAS (Ministry of Agriculture): I am sure I can say with every confidence that the Ministry of Agriculture will be only too delighted to receive and to record any suggestions which may be made between now and the next conference, and to take any steps within its power to ensure that that conference will be a worthy successor to this great one over which you, Sir, have presided.

CHAIRMAN: Before putting to you the motion "That this Conference do now adjourn," there are certain resolutions which, I think you will agree, ought to be passed. I propose to move the first of them myself. It is to this effect:—

> "That the Imperial Agricultural Research Conference tender to the Lord Great Chamberlain their sincere thanks for granting them the use of the Grand Committee room of Westminster Hall, which they have found most suitable and convenient for their meetings."

All I need say, I think, in support of that is this, that this room is of unrivalled historical interest, it is centrally situated, it is well ventilated and well lit, and its dimensions appear to be exactly proportioned to the magnitude of the Conference. No room could have been more convenient.

(*Carried unanimously.*)

DR. J. H. GRISDALE (Canada): We have, during our stay in this country, had many opportunities of visiting different institutions, and at all the institutions and cities to which we have been, whether for a longer or shorter stay, we have been wonderfully well received,

and it is only just and proper to pass a resolution, which we can do with the greatest of pleasure, extending our thanks to these different cities and institutions. I, therefore, have great pleasure in moving :—

> "That the Imperial Agricultural Research Conference record their warmest thanks to the responsible authorities of Great Britain and Northern Ireland for their generous hospitality, and notably to the Universities and Civic bodies concerned, and desire to express their appreciation of the admirable arrangements for the instruction and entertainment of the Conference during their visit. The Conference ask that their thanks may be conveyed to the authorities and persons immediately responsible for these arrangements."

Mr. G. A. Julius (Australia) : I am very glad indeed to be able to second the Resolution proposed by Dr. Grisdale. In doing so, may I say that I think Australia has, in one or two directions, and particularly through Farrer, done pioneer work ; nevertheless, it is fundamentally true that the debt which Australian science owes to British science is so great that Australian science may be regarded as a branch of the British tree of knowledge whose roots are deeply implanted in British soil, and whose main stem is composed of the great institutions which have, during the last month, done so much to make this Conference stimulating, helpful and pleasing.

(*Carried unanimously.*)

Mr. A. Holm (Kenya) : It is my honour and privilege to move a resolution in the following terms :—

> "The Imperial Agricultural Research Conference desire to record their appreciation of the skill and forethought with which the preliminary preparations were made for the Conference, and of the efficiency and energy with which the work of the Conference has been organized and conducted during its meetings, and to tender their sincere thanks to the Organizing Committee, the Executive Committee, and particularly to the Secretariat, on whose ability and industry the work of the Conference has made its heaviest calls which have always been fully met."

I hope that the fact that I am a humble musket bearer in the ranks of this Conference is not a measure of the importance of the resolution which I now move. I cannot in words more forcible than those contained in the resolution convey the expression of the Conference's appreciation of the services rendered by those responsible for organizing this, the first Imperial Agricultural Research Conference. I think a fine example in organization and procedure has been set, and those of us from overseas who are from time to time concerned in work of this kind cannot do better than

endeavour to copy this fine example when we return to our duties in the far-flung portions of the Empire.

Before concluding, I think it is right and proper that I should make special mention of the work of the Secretariat. Its services, I feel sure you will all agree, have reached the maximum of efficiency, and the expeditious discharge of its duties has been truly remarkable.

May I, in an aside, just say that, as with other territories, Kenya has been proud to be associated in the deliberations of this Conference, and I do not doubt but that she will do her share as a unit in the task of promoting Empire work and Empire development.

Mr. R. Hewison (Sudan) : I have the very greatest pleasure in seconding the motion so eloquently proposed by Mr. Holm. I feel he has left very little to be said. The Executive have been commended, and the organization generally has been approved of. I would like, however, to add my little word of appreciation of the work of the Secretariat. Their zeal and efficiency, I think, have been proved in the result, but I think every member of this Conference would like to record the courtesy and the patient forbearance which have characterized their attitude towards the individual members of the Conference.

(*Carried unanimously.*)

Dr. C. J. Reakes (New Zealand) : Before the Conference adjourns there is one resolution I should like to propose and with which I am sure everyone present will cordially agree. We are just concluding a most successful Conference, one which is bound to result in a big impetus to research through the Empire, and a great increase in agricultural advancement, and is sure, I think, to prove of material aid to the prosperity of the agricultural community, both at home and overseas. The success of this Conference has been largely due, I consider—and I am sure you are all with me in this—to the personality of our Chairman and to the able and kindly manner in which he has conducted the proceedings. We came here three or four weeks ago from all parts of the Empire, the majority of us strangers to each other ; we came here to discuss matters of the greatest moment to the Empire, and some of us felt quite strongly about certain matters that affected us particularly ; but notwithstanding the possibilities of differences of opinion causing difficulties, our deliberations have been characterized throughout by good feeling, sound businesslike methods, and absence of any waste of time. We have felt that in all our sittings a sort of beneficent influence has been directing us, and we have learned to regard our Chairman with the highest esteem, and with the greatest respect. I have great pleasure in proposing this resolution :—

" That the Delegates to the Imperial Agricultural Research Conference desire to tender to the Chairman their warmest

thanks for the time and labour which he has devoted to presiding over their proceedings, and to record their admiration of the ability, courtesy and firmness with which he has conducted the business of the Conference."

Colonel G. N. Williams (South Africa): I feel it a great privilege to be able to second the resolution which I know comes from the hearts of all present. The resolution expresses our feelings towards you, Sir, but I should like to add the tribute of my admiration—and I am sure the admiration of all of us—to your physical prowess. We all know that Lord Bledisloe plays no mean part in the administration of the Department concerned with the primary industry in England. We feel exhausted after a day's session, and Lord Bledisloe's normal day's work only commences then; but we see him here, debonair, smiling, fresh, in readiness to preside over us in the admirable manner which is instanced in the resolution.

I would also like to say that all of us, more particularly those who have been associated with you on the Executive Committee and in the Administrative Commission, have learned that you have been to us far more than a Chairman. Not only have we had the advantage of your great stores of experience and knowledge in matters appertaining to agriculture, but we have always felt when we have had the benefit of your advice that we were having the advice of a personal friend. That has been a very great contributing factor to the success of this Conference. We all know that the ultimate success of the Conference will be in relation to the manner in which it may be adopted by the respective Governments. I think that the recommendations of the Conference have been couched in terms most calculated to secure success, and as a member of the Executive I should like to say this, that four-fifths of any success which we may attain will be due to the personal efforts and personal advice of our Chairman. Sir, nothing has given me greater pleasure than to be able to second this resolution, which I hope will be carried with acclamation.

Major Walter Elliot (Empire Marketing Board): Gentlemen, this is perhaps the only resolution of the Conference with which our Chairman would be incompetent to deal, not because, I am sure, of any lack of competence, but because the natural modesty which is, if I may say so, one of the most charming features of a very charming personality, would preclude him from putting this, or even suggesting it should be put, to the Conference, or even perhaps from admitting that it obviously has been carried now with acclamation. I do not intend to put this motion to the meeting at all: I merely rise to say as temporary chairman, having seized that position for the moment, that this motion was put to the meeting and has since then been carried with acclamation.

CHAIRMAN : Never do I feel so hopelessly incompetent as when having to acknowledge a personal tribute such as that which has been moved in much too laudatory language by my friends Dr. Reakes and Colonel Williams, endorsed most kindly by Sir Herbert Read, and received with such wholly undeserved acclamation. I only want to tell you this, that in carrying out the task which you have laid upon me I am glad to think that I have earned your confidence. When you called upon me to be your Chairman, I am bound to tell you I was apprehensive as to my competence to carry out so difficult a task, but I should like to say, particularly apropos of what Sir Herbert Read has said, that no task throughout my public career has been a more pleasant one to me, and in fact I may say that no task that I can remember has been more thoroughly congenial.

My task, however, would have been impossible—quite frankly—but for the invaluable support which I have received, first of all, from my three Vice-Chairmen, Lord Lovat, Mr. Ormsby Gore, and Major Elliot, all of whom have introduced discussions on the three important administrative questions with very great skill and ability, as I am sure you will admit ; to Mr. Dale, the Chairman of the Finance and Organizing Sub-Committee of this Conference, to whom really I cannot sufficiently express my personal thanks for his assistance ; to Sir William Furse, the Chairman of the Travelling and Entertainment Committee, whose services I am sure you can fully appreciate as having partaken richly in their results ; and particularly to the Secretariat, to whom a well-deserved tribute has already been paid, presided over with great ability by Mr. Black, our Secretary ; but above all to the ever sympathetic and unfailing and loyal support which I have received from every member of this Conference. I cannot say more, because quite frankly I am very much touched by the kind way in which you have given me this undeserved tribute. All I can say is this, that if at any time in the future I am called upon to carry out similar duties on your behalf or on behalf of agricultural science in any part of the British Empire, I shall be pleased again to do my best.

I now have to put to the Conference this motion that the Conference be now adjourned until the year 1932, to resume then in Australia.

(*Carried unanimously.*)

(The Conference then adjourned until 1932.)

V. APPENDICES.

APPENDIX A.

LIST OF DELEGATES AND REPRESENTATIVES.

(i) DELEGATES.

(a) Overseas.

DOMINIONS AND INDIA.

Canada	Dr. J. H. Grisdale, D.S.A. E. S. Archibald, B.A., B.S.A. W. T. Macoun. Dr. E. A. Watson. Dr. J. M. Swaine. Dr. H. Ashton, M.A., D.Lett., D.Litt., F.R.C.S.
Commonwealth of Australia	G. A. Julius, B.Sc., B.E.Mech.E. Dr. S. S. Cameron, D.V.Sc., M.R.C.V.S. Professor A. E. V. Richardson, M.A., D.Sc. Dr. G. P. Darnell-Smith, D.Sc., F.I.C., F.C.S. A. W. Turner, B.V.Sc. F. L. McDougall, C.M.G.
New South Wales ...	A. T. R. Brown.
Queensland	H. W. Kerr.
New Zealand	Dr. C. J. Reakes, C.B.E., D.V.Sc., M.R.C.V.S. T. Rigg, M.A., M.Sc. R. E. R. Grimmett, M.Sc.
Union of South Africa	Lt.-Col. G. N. Williams, D.S.O. Dr. P. J. du Toit, B.A., Ph.D., Dr.Med.Vet. E. A. Griffiths. H. H. Storey, B.A. F. J. du Toit, B.A.
Irish Free State ...	Dr. J. H. Hinchcliff, Ph.D. Dr. P. A. Murphy, A.R.C.Sc.I., B.A., Sc.D. J. H. Norris, M.R.C.V.S. A. Poole-Wilson.
Southern Rhodesia ...	Major G. N. Blackshaw, O.B.E., B.Sc., F.I.C.
India	Dr. F. J. F. Shaw, D.Sc., F.L.S.
Burma	D. F. Chalmers. T. D. Stock, B.Sc.
Madras	R. W. Littlewood. F. Ware, F.R.C.V.S.
Punjab	D. Milne, B.Sc. Col. G. K. Walker, C.I.E., O.B.E., F.R.C.V.S., I.V.S.

COLONIES, PROTECTORATES, &c.

Barbados	Professor J. P. d'Albuquerque, M.A., F.I.C., F.C.S.
British Guiana ...	R. A. Altson, B.Sc., A.R.C.S. Dr. C. L. Whittles, B.A., Ph.D.

Ceylon	M. Crawford, M.R.C.V.S. F. P. Jepson, M.A., F.E.S.
Rubber Research Scheme	R. A. Taylor, B.Sc.
Cyprus	R. J. Roe, M.R.C.V.S.
Federated Malay States and Straits Settlements.	A. S. Haynes (also representing Board of the Rubber Research Institute of Malaya). A. Sharples, A.R.C.S., D.I.C. (also representing North Borneo).
Board of the Rubber Research Institute of Malaya.	A. S. Haynes. F. L. Engledow, M.A.
Gambia	A. J. Brooks, F.L.S., F.C.S., F.R.H.S.
Gold Coast	G. G. Auchinleck, M.Sc., F.I.C. R. H. Bunting, F.L.S. W. H. Patterson, M.B.E. A. C. Miles.
Iraq	F. K. Jackson.
Kenya	A. Holm, C.B.E., F.H.A.S. Lt.-Col. A. G. Doherty, M.C., M.R.C.V.S. V. A. Beckley, M.A., F.I.C., F.C.S.
Leeward Islands ...	F. H. S. Warneford, M.A., B.Sc., A.I.C., F.C.S.
Malta	Sir Gerald Strickland, G.C.M.G., M.P.
Mauritius	Sir Herbert J. Read, K.C.M.G., C.B. E. F. S. Shepherd, B.S.A.
Nigeria	P. H. Lamb, N.D.A. F. R. Brandt. G. H. Jones, M.A.
Northern Rhodesia ...	J. Smith.
Nyasaland	J. A. Griffiths, F.R.C.V.S., F.Z.S.
Palestine	H. Raczkowski
Sierra Leone	K. G. Burbridge. H. C. Doyne. P. J. Moss.
Tanganyika Territory	A. H. Kirby, B.A. H. E. Hornby, F.R.C.V.S. A. H. Ritchie.
Amani Research Institute	W. Nowell, D.I.C., F.L.S.
Trinidad, Grenada, and Windward Isles	W. G. Freeman, B.Sc., A.R.C.S., F.L.S. G. A. Jones.
Imperial College of Tropical Agriculture.	A. Aspinall, C.M.G., C.B.E., B.A. Professor Sir J. B. Farmer, M.A., D.Sc., F.R.S. Professor C. Y. Shephard, B.Sc.(Econ.).
Uganda	A. B. Killick, B.Sc.
Zanzibar	L. W. Raymond, B.A., B.Sc., A.I.C., A.R.C.S. J. E. Baker.
**The Sudan*	Sir G. E. Schuster, K.C.M.G., C.B.E., M.C. R. Hewison, C.B.E. Major R. G. Archibald, D.S.O., M.D. Dr. A. F. Joseph, D.Sc., F.I.C.

* These are not official delegates but experts lent by the Sudan Government.

(b) Great Britain and Northern Ireland.

Ministry of Agriculture and Fisheries (including the Royal Botanic Gardens, Kew)
The Rt. Hon. Walter Guinness, D.S.O., M.P.
The Rt. Hon. Lord Bledisloe, K.B.E. (*Chairman of Conference*).
Sir Charles J. H. Thomas, C.M.G.
Sir Daniel Hall, K.C.B., F.R.S.
Dr. A. W. Hill, C.M.G., F.R.S.
J. R. Jackson, M.R.C.V.S.
H. E. Dale, C.B.
H. G. Richardson.

Dominions Office.
Lord Lovat, K.T., K.C.M.G., K.C.V.O., C.B., D.S.O.
A. C. C. Parkinson, O.B.E.

Colonial Office.
The Rt. Hon. W. G. A. Ormsby-Gore, M.P.
O. G. R. Williams.

India Office.
Sir Henry Staveley Lawrence, K.C.S.I.

Empire Marketing Board.
Major Walter Elliot, M.C., M.P.
S. G. Tallents, C.B., C.B.E.
E. M. H. Lloyd.

Development Commission.
Lt.-Col. Sir David Prain, C.M.G., C.I.E., LL.D., F.R.S.
R. T. Warner.

Department of Scientific and Industrial Research.
Sir Wm. B. Hardy, F.R.S.
H. T. Tizard, C.B., F.R.S.
E. Barnard, D.S.O.

Imperial Institute.
Lt.-Gen. Sir W. T. Furse, K.C.B., D.S.O.

Board of Agriculture for Scotland.
Sir R. B. Greig, M.C., LL.D., M.Sc., F.R.S.E.
Charles Weatherill.

Ministry of Agriculture for Northern Ireland.
Dr. J. S. Gordon, C.B.E.
James Pimlott.

Department of Overseas Trade.
R. W. Matthews, C.M.G.

Forestry Commission.
R. L. Robinson, O.B.E.

Medical Research Council.
Sir Walter Fletcher, K.B.E., M.D., Sc.D., F.R.S.

Imperial Bureau of Entomology.
Dr. G. A. K. Marshall, C.M.G., F.R.S.

Imperial Bureau of Mycology.
Dr. E. J. Butler, C.I.E., D.Sc., F.R.S.

Overseas Settlement Department.
G. F. Plant.

Board of Education.
W. R. Davies, C.B.

University Grants Committee.
A. H. Kidd.

Scottish Education Department.
Sir George Macdonald, K.C.B.

Linen Industry Research Association.
Dr. W. H. Gibson, O.B.E., D.Sc., F.I.C., F.Inst.P.
G. O. Searle.

Empire Cotton Growing Corporation.
Sir James Currie, K.B.E., C.M.G.
Sir William Himbury, Kt.
S. Milligan.

High Commissioner for Canada.
W. A. Wilson.

High Commissioner for South Africa.
The Hon. J. S. Smit, H.C.

High Commissioner for Australia.
F. C. Faraker.

High Commissioner for New Zealand.
The Hon. Sir Christopher James Parr, K.C.M.G., H.C.
S. C. Manhire.

High Commissioner for Southern Rhodesia.
Sir F. J. Newton, K.C.M.G., C.V.O.

High Commissioner for Irish Free State.
James McNeill, H.C.

High Commissioner for India.
Sir A. C. Chatterjee, K.C.I.E., H.C.
R. E. Montgomery.

(ii.) REPRESENTATIVES.

(c) Members of the Agricultural Research Council of Great Britain.

T. Anderson, M.A., B.Sc.
Dr. W. H. Andrews, M.R.C.V.S.
Professor B. T. P. Barker, M.A.
Dr. W. F. Bewley, D.Sc.
Sir R. H. Biffen, M.A., F.R.S.
Professor V. H. Blackman, D.Sc., F.R.S.
Dr. O. C. Bradley, M.D., D.Sc.
Professor J. B. Buxton, F.R.C.V.S.
J. M. Caie.
A. D. Cotton, F.L.S.
Dr. F. A. E. Crew, M.D., D.Sc., Ph.D.
Dr. C. Crowther, M.A.
P. G. Dallinger, O.B.E.
J. C. F. Fryer.
Professor S. H. Gaiger, F.R.C.V.S.
R. G. Hatton, M.A.
Professor James Hendrick, B.Sc., F.I.C.
Dr. A. D. Imms, M.A., D.Sc., F.L.S.
C. Bryner Jones, C.B.E.
Professor R. T. Leiper, M.D., D.Sc., F.R.S.
A. McCallum.
Sir John M'Fadyean, M.B., B.Sc., M.R.C.V.S., LL.D.
Dr F. H. A. Marshall, F.R.S.
Dr. F. C. Minett, D.Sc., M.R.C.V.S.
Dr. J. B. Orr, D.S.O., M.C., M.A., D.Sc., M.D.
C. S. Orwin, M.A.
Dr. B. J. Owen, M.A., D.Sc., M.Eng.

W. H. Parker, M.C., M.A.
Dr. G. H. Pethybridge.
W. A. Pool, M.R.C.V.S.
Professor R. C. Punnett, M.A.
W. Robb, N.D.A.
Sir John Russell, K.B.E., D.Sc., F.R.S.
J. Henderson Smith, M.B., Ch.B.
Professor R. G. Stapledon, M.A.
H. V. Taylor.
Dr. R. Stenhouse Williams, M.B., D.Sc.
Professor T. B. Wood, C.B.E., F.R.S.

(d) Other Representatives.

Dr. A. G. Bagshawe, C.M.G., M.B., D.Ph.
Dr. C. A. Barber, C.I.E., D.Sc.
E. S. Beaven.
Sir Merrik Burrell, Bt.
Sir David Chadwick, C.S.I., C.I.E.
Major R. D. Furse, D.S.O.
W. Gavin, C.B.E.
Dr. H. H. Green.
Sir Richard Gregory, D.Sc., F.Inst.P., F.R.A.S.
D. A. E. Harkness, M.A.
Dr. C. B. Hutchison.
Sir F. Keeble, F.R.S.
Professor R. H. Leitch.
The Rt. Hon. Sir Halford Mackinder.
Professor Sir C. J. Martin, C.M.G., F.R.S.
T. A. M. Martin.
C. G. T. Morison, M.A.
Professor G. Scott Robertson, D.Sc.
Professor G. W. Robinson, M.A.
Sir Ernest Rutherford, O.M., O.B.E.
Sir Louis Souchon, Kt., C.B.E.
Dr. A. T. Stanton, M.D., F.R.C.P.
Sir Arnold Theiler, K.C.M.G.
Professor R. S. Troup, C.I.E., M.A., D.Sc., F.R.S.
Christopher Turnor.
J. A. Venn, M.A.
Dr. J. A. Voelcker, M.A., Ph.D.
Trevor H. Walsh.
Professor J. Scott Watson.
C. Dampier Whetham, M.A., F.R.S.
R. M. Wilson, B.Sc., (Agric.).

Secretary of Conference.
W. R. Black, 10, Whitehall Place, London, S.W. 1.

MEMBERS OF ORGANISING COMMITTEE.

The Rt. Hon. Lord Bledisloe, K.B.E. (Chairman),
Ministry of Agriculture and Fisheries.
Dr. E. J. Butler, C.I.E., D.Sc., F.R.S.,
Imperial Bureau of Mycology.
Sir James Currie, K.B.E., C.M.G.,
Empire Cotton Growing Corporation.

H. E. Dale, C.B.,
Ministry of Agriculture and Fisheries.
Major Walter Elliot, M.C., M.P.,
Scottish Office and Empire Marketing Board.
F. C. Faraker,
Officer of High Commissioner for Australia.
Lieut.-General Sir W. T. Furse, K.C.B., D.S.O.,
Imperial Institute.
Sir A. D. Hall, K.C.B., F.R.S.,
Ministry of Agriculture and Fisheries.
Sir W. B. Hardy, F.R.S.,
Department of Scientific and Industrial Research.
Dr. A. W. Hill, F.R.S.,
Royal Botanic Gardens, Kew.
T. J. Kiernan,
Office of High Commissioner for the Irish Free State.
S. C. Manhire,
Office of High Commissioner for New Zealand.
A. McCallum,
Board of Agriculture for Scotland.
Dr. G. A. K. Marshall, C.M.G., F.R.S.,
Imperial Bureau of Entomology.
R. E. Montgomery,
Office of High Commissioner for India.
A. C. C. Parkinson, O.B.E.,
Dominions Office
James Pimlott,
Ministry of Agriculture for Northern Ireland.
H. G. Richardson,
Ministry of Agriculture and Fisheries.
S. G. Tallents, C.B., C.B.E.,
Empire Marketing Board.
H. T. Tizard, F.R.S.,
Department of Scientific and Industrial Research.
F. J. du Toit, B.A.,
Office of High Commissioner for the Union of South Africa.
E. J. Turner, C.B.E.,
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J. A. T. Walters,
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Bureau of Hygiene and Tropical Diseases.
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Professor J. B. Buxton, M.A., F.R.C.V.S.,
Institute of Animal Pathology, Cambridge.
R. G. Hatton, M.A.,
East Malling Research Station.
W. P. Hildred,
Empire Marketing Board.
L. G. Killby,
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Imperial Economic Botanist, India.
Sir G. E. Schuster, K.C.M.G., C.B.E., M.C.,
Expert lent by the Sudan Government.
Professor T. B. Wood, F.R.S.,
Animal Nutrition Research Institute, Cambridge

APPENDIX B.

AGENDA MEMORANDA ON ADMINISTRATIVE QUESTIONS.

AGENDA : MEMORANDUM 1.

Recruitment, Training and Interchange of Workers.

The questions for consideration are how far it is desirable and practicable that arrangements on an Imperial basis should be made for the recruitment, training and interchange of research workers in agriculture and what these arrangements should be.

The existing position in regard to the supply, recruitment and training of research officers for the scientific departments of the Empire was considered by a special Sub-Committee of the Imperial Conference in 1926. Part II of the Committee's Report is re-printed as Appendix Paper 1.*

Recruitment.—Particulars of schemes of recruitment of research workers for Great Britain and the Colonies are given in Appendix Paper 2.*

Since the inception of the research institute and advisory schemes the agricultural research workers and advisory officers in Great Britain have been recruited largely by means of research scholarships, which have proved extraordinarily successful for the purpose. Of 80 research scholars still living, 62 are still engaged in research, advisory and teaching work in this country or in the Overseas Empire (and of these very few occupy teaching posts). Many of the outstanding research and advisory workers in this country have been recruited in this way. It has been found necessary to award up to ten scholarships annually, and it is probable that the annual casualties in the research and advisory services in Great Britain will necessitate the award of fully as many as this number in the future.

In 1925, following the report of a Committee, of which Lord Milner was Chairman (until succeeded on his death by Lord Lovat), a scheme of scholarships was initiated by the Colonial Office for the non-self-governing Dependencies. Sixteen to eighteen scholarships in Agriculture and Agricultural Science are at present being awarded annually, so as to form a pool from which vacancies in the Colonial Agricultural Departments can be filled. A similar scheme of scholarships has been established by the Empire Cotton Growing Corporation.

Particulars of both these schemes are given in Appendix Paper 2 *; whilst Appendix Paper 3* gives an account of the working of the Colonial Office Scheme up to the end of its second year.

It will be understood that the Colonial Office and the Empire Cotton Growing Corporation award more than half of their scholarships to candidates who intend to take up the administrative side of agriculture rather than research.

No particulars have been received of research scholarships awarded by the Dominion Governments. No doubt delegates from the Dominions will be able to supply the Conference with information concerning any schemes which may be in operation.

It should be made clear that there is at present no co-operation in regard to the award of scholarships between the Colonial Office, the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland, and the Empire Cotton Growing Corporation, beyond the issue of the joint notice

* See note at end of Appendix.

which is printed as Appendix Paper 2*. This notice is circulated to schools, colleges, Universities and other institutions throughout the country.

Particulars of vacancies in Research Institute and Advisory Centre staffs in England and Wales are circulated amongst the research scholars of the Ministry; and this arrangement could perhaps with advantage be extended to Scotland. In present circumstances it does not appear that any useful purpose would be served by circulating these particulars to Colonial Office scholars, who at as early a date as possible in their course will be specially trained for definite vacancies as soon as these can be foreseen, or by circulating particulars of Colonial Office vacancies to the Ministry and Board of Agriculture for Scotland scholars.

If the Conference agree that a scheme of research scholarships is a desirable method of recruitment of officers, the main question for discussion would appear to be whether an attempt should be made to merge present scholarship schemes in an Imperial scheme.

An Imperial scholarship scheme would seem to necessitate agreement as to :—

(1) The annual number of vacancies to be catered for in different subjects.
(2) Qualifications necessary in candidates in view of the different Universities from which they would be drawn.
(3) The grouping of countries for the functioning of selection bodies for the preparation of short lists.
(4) The composition of any Imperial body making the final selection from the short lists; perhaps constituted from representatives of the different Bureaux, Government Departments and High Commissioners.
(5) The arrangements for training (see later section).
(6) And—perhaps most important of all—the question as to whether scholars would be bound to accept employment, if offered, for a term of years, and, if so, the extent to which they should be entitled to restrict the area to which they would be liable to be allocated.

An Imperial scholarship scheme would also seem to involve the circulation among all available scholars of particulars of vacancies in their specialist subjects; and it would probably also have to be agreed that vacancies throughout the Empire should not be filled until scholars had had an opportunity of applying.

It appears difficult to bring the Dominions and India into a general scheme: their position differs from that of the Colonies. The latter have practically no training institutions of University status of their own, and naturally look to this country as their primary field of recruitment. The Dominions and India, on the other hand, have their own sources of supply of young graduates with a good, scientific training, and would expect that their Research Service shall be staffed to the utmost extent possible from their own people. Again, the administrative difficulties of working a scheme of selection for the whole Empire would obviously be great: how, for instance, could it be conveniently and easily secured that justice should be done between the competing claims of young chemists from Sydney, Montreal, and Cambridge? The best means of selection—personal interview or private discussion with the candidates' tutors—would be impossible.

These difficulties might, however, conceivably be overcome.

Training of scholars.—(Training is used to refer to post-graduate work previous to obtaining a post as research worker.) The training of research scholars of the Ministry and Board of Agriculture for Scotland consists of two years' work at a research institute in this country and one year at a research institute or laboratory abroad. The year abroad has usually been spent in the United States or on the Continent. The training of Colonial

* See note at end of Appendix.

Office research scholars is of two years' duration. One year is spent in this country at research institutes and the second year at the Imperial College of Tropical Agriculture, Trinidad. If an Imperial body is set up for the selection of scholars it might also arrange for their training, and in this connection it should make use of Empire facilities when arranging programmes of work. The amount of the scholarship allowances would need to be fixed with reference to the country in which the scholarships were tenable, and the finance of any Imperial scholarship scheme would need careful consideration.

Interchange of Workers.—It is necessary under this heading to distinguish between three separate questions :—

(*a*) Visits by workers of standing to other parts of the Empire to familiarize themselves with the progress of research and the development of technique in their own special subjects, or subjects connected with them.

(*b*) Attendance at Research Institutes by comparatively junior workers on study leave, whether for definite courses of instruction or simply for the opportunity of working at the Institutes and seeing how things are done.

(*c*) Interchange for fairly long periods (two or three years or more) between workers who for the time being really become members of the staffs of the institution into which they are "interchanged."

On these three matters :—

(*a*) is scarcely "interchange," and needs little comment. In Great Britain a certain sum of money is provided annually for the award of grants to research and advisory workers, to enable them to pay visits to Research Institutes, &c., abroad, and also to enable them to attend International Conferences on their own subjects. These "Travelling Research Fellowships" have usually been of three months' duration and £250 in value and have been mainly tenable in the United States. Fellowships of less value for similar periods have also been awarded for visits to the Continent. As a rule some half-dozen Fellowships are awarded annually in Great Britain together with a few grants for expenses of attendance at international Conferences. In future arrangements for these Fellowships the facilities available in the Empire will, of course, be borne in mind.

It seems desirable that such a system of Fellowships should be general throughout the Empire. The Research Sub-Committee of the Imperial Conference attached much importance to the provision of study-leave for the purpose (see Appendix Paper 1,* and also Appendix Papers 5 to 11*). Financial assistance might possibly be obtained from such a source as the Empire Marketing Board.

It may presumably be taken that anywhere in the Empire visitors of this kind would be welcomed and given every facility, free of charge, to see what is happening. It is clear that the expenses of such visits should be borne by the Institution from which the visitor comes.

If, however, it should happen that a picked officer is sent to visit Institutes throughout the Empire dealing with his own subject, in order to assist the staffs of these latter Institutes, the cost could hardly fall on the Institution from which he came. It would presumably be borne either by the countries which he visits, or else by a special grant from such a source as the Empire Marketing Board.

(*b*) again is scarcely "interchange" but presents rather more difficulties. Research Institutes often have no really suitable accommodation for the instruction of any considerable number of students; and

* See note at end of Appendix.

teaching or lecturing takes away a worker from his permanent duties. Again there are administrative and financial questions to be settled. In this connection it will be remembered that in Great Britain Research Institutes are usually governed by, and are parts of, Universities and therefore are not autonomous in such matters as laboratory fees.

An idea of the facilities available in each country for research into the various subjects by men on study-leave can be obtained from two Conference publications, on Agricultural Research in Great Britain and Northern Ireland and in the Overseas Empire respectively. The last few years have witnessed important developments in animal diseases research in this country : a special statement is therefore included in the Appendix Paper 12* of facilities in this subject in Great Britain.

No doubt the representatives of the various parts of the Empire at the Conference will express their wishes in this matter, and the authorities responsible for Research Institutions will do their utmost to meet them.

(*c*) The proposal under this heading is novel, and needs exploration. Probably cases would not be frequent, and details could be settled individually between the Institutions concerned as cases arise. The general principle might perhaps be that the Institute to which a man belongs permanently would continue to pay his salary, but that the Institute to which he is temporarily attached would bear all other expenses, including any addition necessary on account of the varying cost of living (see the memorandum of the Division of Chemistry, Department of Agriculture, Union of South Africa—Appendix Paper 8*).

On the point as to who is to take the initiative in such interchanges, it looks as if this will need to be left to the Directors of individual Research Institutes, and to the individual workers. It would seem impossible for an outside body or persons to compel interchanges, if either the Institutes themselves or the men concerned were unwilling. But perhaps the Governing Bodies and Directors of Research Institutes throughout the Empire might be asked to bear in mind the possibility and advantages of such interchanges : and the larger Institutions might make it a rule that they would be prepared always to have at least one member of their staff serving in another part of the Empire, and a member of another Institution taking his place.

AGENDA : MEMORANDUM 2.

Proposed Chain of Tropical and Sub-Tropical Research Stations.

1. The Research Special Sub-Committee of the Imperial Conference, in referring to the possibility of establishing new Research Stations in suitable centres in the tropical and sub-tropical parts of the Empire, pointed out that " the ultimate idea is the creation of a chain of research stations linked together by a common interest in related problems, and providing a fertile field for team work and the interchange of ideas and men throughout the Empire." (Report of Research Special Sub-Committee, page 14, para. 66—Appendix Paper 2.)*

2. The Imperial Conference passed a resolution expressing its cordial approval of " the project of fostering a chain of research stations situated in

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* See note at end of Appendix.

appropriate centres in tropical and sub-tropical parts of the Empire, and commending this project to the sympathetic consideration of Governments, Institutions and private benefactors throughout the Empire." (Cmd. 2768, p. 50—Appendix Paper 3.)*

3. The Colonial Office Conference accepted "the necessity for a chain of group research stations throughout the Empire," and pointed out that for this purpose the Colonies fell into the following groups: West Africa, East Africa, West Indies, the Far East, and possibly the Middle East. (Cmd. 2883, p. 34—Appendix Paper 4.)*

4. The Governments of the Empire have thus unanimously agreed that measures should be taken to establish an Empire chain of research stations on tropical and sub-tropical agriculture. There can however be no question of hastily summoning into being a number of new stations of this kind. The lack of trained men qualified to run them would alone prohibit any such immediate step. On the other hand the Imperial Agricultural Research Conference offers an exceptionally good opportunity for a discussion of the subject, and for the framing of a provisional programme, as a guide to those who may have opportunities in the coming years of forwarding its execution. The purpose of this paper is to indicate the present organization of tropical and sub-tropical research and to inform the Conference of certain proposals which have been discussed or are in contemplation. The information which it gives and the suggestions which it records can no doubt be supplemented by those attending the Conference.

Existing Organizations.

5. Although tropical and sub-tropical agriculture present specific problems of their own, there is no complete severance between the needs of tropical, sub-tropical and temperate agriculture. The relation, therefore, between the proposed chain of stations and the research stations already existent in the United Kingdom and other temperate parts of the Empire must not be lost sight of. In the following paragraphs an account is given of some of the existing institutions in tropical and sub-tropical parts of the Empire which should be considered in the framing of any long-range programmes.

6. *The Imperial College of Tropical Agriculture, Trinidad.* This College is the only adequately equipped training centre and the principal research institute in the Colonial Empire. It was opened in October, 1922, and was granted a Royal Charter in November, 1926. The total capital expenditure upon the College has been in the neighbourhood of £150,000, and the maintenance charges amount to about £25,000 per annum, contributions towards which have in the past been made by the Imperial Government, and by the West Indian Colonies by a ½ per cent. levy on their revenues. Lately the Empire Marketing Board and the Empire Cotton Growing Corporation have each made a grant of £21,000 towards further capital expenses of the College and the Empire Marketing Board has made a grant in aid of revenue of £8,000 in respect of the financial year ending August 31st, 1927.

7. The professorial staff of the College consists of 1 Principal, 8 Professors and 9 Lecturers. The College provides a three-years' course for its Diploma in Tropical Agriculture, and a one-year's course which is largely followed by students passing on to the Agricultural Departments in various Colonies. There are now 42 students in residence at the College.

8. The College publishes a monthly journal entitled "Tropical Agriculture," and in addition to teaching work undertakes research on such subjects as the breeding of varieties of banana immune to Panama disease, the froghopper pest of sugar cane, wither-tip disease in limes, and the study of colloidal soils.

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* See note at end of Appendix.

9. *The Amani Institute.*—The only other overseas research station of a definitely Imperial or inter-Colonial character is the Institute at Amani, where work is about to be restarted. As the functions of this Institute will be exclusively research, it is probably nearer to the type of the new stations contemplated than is the Imperial College.

10. The six Governments of Tanganyika, Kenya, Uganda, Zanzibar, Northern Rhodesia and Nyasaland are providing between them an annual contribution amounting to £8,000, and the Empire Marketing Board is making a grant up to one-third of the total running costs, not exceeding £6,000 in any one year. The capital expenditure required will be charged to the East African Guaranteed Loan.

11. The new Director of the Amani Institute is Dr. Nowell. The object of this research station will be to undertake problems of long range research, and to supplement more particularly the research activities of the East African Dependencies. (See also Appendix Paper 10.)*

12. *South Africa.*—The remarkable work of the Veterinary Research Institute at Onderstepoort must be recorded in any account of the outstanding overseas institutions already engaged in research affecting the tropical and sub-tropical parts of the Empire. The work of this Institute is too well known to require a special description in this paper.

13. *India.*—The research organizations of India do not normally undertake fundamental work on the same basis as some of the institutions in the United Kingdom, but they must not be overlooked in such a survey as the present. India has the Imperial Agricultural Research Institute and College at Pusa, the Imperial Institute of Agricultural Husbandry and Dairying at Bangalore and another institute of the same name at Wellington in Madras, an Imperial Cattle Breeding Farm in the Punjab, an Imperial Dairy Factory at Anand in Bombay, the Institute of Plant Industry at Indore, and the special research stations for sugar cane at Coimbatore and for cotton at the Bombay Technological Laboratory. These are all central Institutions under the Government of India.

New Stations Proposed.

14. The following new stations have already been discussed or proposed :—

(i) *Australia.*—The Commonwealth Government, in consultation with the Empire Marketing Board, are planning a Research Station in Northern Queensland. The capital cost (estimated at £50,000) and the maintenance expenditure (estimated at £10,000 per annum) would be shared equally by the Empire Marketing Board and the Australian Government. It has been suggested that this station should act as a centre for research in animal husbandry and nutrition in the tropics and possibly also for pasture problems (Appendix Paper 7).*

(ii) *Ceylon.*—It is understood that the establishment of a station at Peradeniya is being considered by the authorities who are considering the Report of the Colonial Office Conference.

(iii) *East Africa.*—It has been suggested that a central station for veterinary research should be established at Kabete, Kenya Colony. (Appendix Paper 6.)*

(iv) *West Africa.*—The Colonial Office Conference noted that the West African Colonies had reached the stage of holding group conferences for the allocation of research work between them. It is understood that the ultimate establishment of a West African Station is probable. (Appendix Paper 11.)*

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* See note at end of Appendix.

(v) *Federated Malay States.*—Suggestions have been made for a central station in the Federated Malay States to undertake tea and rubber research.

(vi) *Stations for Sugar and Copra Research* have also been suggested. It is for consideration whether new stations would be required for this purpose, or whether each subject could be dealt with by one of the stations which exist or are in immediate contemplation. (Appendix Paper 9.)*

(vii) *A Station for Irrigation* has been suggested and it has been thought that such a station might most advantageously be established in the Middle East.

15. This memorandum does not deal with the question of relations between research stations, e.g., interchange of workers, &c., which are dealt with in other Conference papers. (Agenda Memoranda 1, 3, 4 and 5.)

AGENDA : MEMORANDUM 3.

Imperial Bureaux.

Views of the Imperial Conference, 1926.

1. The Research Special Sub-Committee of the Imperial Conference referred to the great value of the work of the Imperial Bureaux of Entomology and Mycology, and suggested that "further Bureaux of a similar kind might well be established in other sciences as the need for them is realized and the constituent parts of the Empire agree to their establishment." (Report of Research Special Sub-Committee, p. 4, para. 2, Appendix Paper 2.)*

The Imperial Bureau of Entomology.

2. The Imperial Bureau of Entomology was founded in the beginning of 1913, and is supported by contributions from the Imperial Government, the Governments of the self-governing Dominions and Colonies, the Governments of India, the Colonies and other Dependencies, the Sudan, and the North Borneo Company. The cost of the Bureau is approximately £12,500 per annum.

3. The Bureau publishes a monthly "Review of Applied Entomology" which summarizes all the current entomological literature that bears upon insects that are injurious or in any way economically important, also a quarterly journal known as the "Bulletin of Entomological Research," which includes original papers on entomological subjects.

4. A very important item in the functions of the Bureau is the identification of insects for official entomologists in all parts of the Empire. Information and advice is given on all matters concerning injurious insects, and lately, with the aid of a grant from the Empire Marketing Board, a laboratory has been set up for the breeding of beneficial parasites for export to the Dominions and Colonies. Finally the Bureau sets out to help the individual researcher in the Colonies in many ways, by undertaking translations, hunting up references, preparing illustrations and publishing papers.

The Imperial Bureau of Mycology.

5. The Imperial Bureau of Mycology was founded in 1920 for the encouragement and co-ordination of work throughout the Empire on those

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* See note at end of Appendix.

diseases of economic plants caused by fungi. The funds of the Bureau are entirely provided by the self-governing Dominions, India and the Sudan, and the non-self-governing Colonies and Protectorates. It is a parallel in every way to the Bureau of Entomology and performs similar functions for the economic Mycologists overseas, distributing information in all matters connected with plant diseases, and undertaking the identification of specimens. The Bureau has only one publication, a monthly "Review of Applied Mycology."

The Royal Botanic Gardens, Kew.

6. The Royal Botanic Gardens fulfil in many ways the functions of a "Bureau of Economic Botany." The Director of Kew is the Botanical Advisor to the Secretary of State for the Colonies, and officials of Kew (as in the case of the two Bureaux) make periodical visits to the overseas parts of the Empire, where they give advice on the cultivation and importation of different varieties of economic plants, &c. Publications have been issued from Kew dealing with the flora of nearly all parts of the Empire.

The functions and characteristics of a Bureau.

7. An examination of the work of these three Centres suggests that the essential function of a Bureau is the collection and dissemination of information, and the provision of a means whereby overseas workers can readily obtain reference to the appropriate specialists and research centres in this country, and also can be kept in touch with the work carried out in other parts of the Empire, or outside it.

Through periodical Conferences a Bureau can enable its scattered workers to develop a team spirit and speak as an organized body and between Conferences it can to some extent act as a standing committee for the workers in that field.

8. On the other hand it is clear that a Bureau is not the only method of securing these objects. The functions which a Bureau in certain circumstances is specially qualified to perform would in other fields of work, and especially at certain stages in their development, be more naturally dealt with by alternative methods, in particular:—

i. by correspondence between outlying workers and workers at a central or outstanding Research Station;

ii. by Congresses with standing Committees of workers in a particular subject; or

iii. by an unspecialized Bureau for the dissemination of general agricultural research information. In this connection the proposal has been made by the Colonial Office Conference (Cmd. 2883, p. 44—Appendix Paper 3)*, and further developed in the paper which is being circulated to the Conference as Memorandum No. 4—Interchange of Information—that the Imperial Institute should be constituted as a general and unspecialized Centre for the distribution of information concerning all kinds of research not covered by the Specialized Bureaux.

9. So far as existing experience can be taken as a guide, it appears to be a pre-requisite of a Bureau:—

i. that the subject dealt with should be well defined;

ii. that the outlying workers should be sufficiently numerous;

iii. that the duties of those workers should not merely comprise research in one special branch of the subject in question, but should include, as a general rule, administrative or advisory work in the subject as a whole;

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* See note at end of Appendix.

iv. that there should be within the Empire a sufficiently self-contained field to justify the creation of an Imperial Bureau.

10. These critera may at least be convenient in considering the desirability of the following new Bureaux that have been suggested, and any others that may be suggested at the Conference :—

i. *Bureau of Veterinary Research,* suggested by the Research Special Sub-Committee of the Imperial Conference, (Appendix Paper 2)* by Sir Arnold Theiler (Appendix Paper 4)* and by South Africa (Appendix Paper 5).*

ii. *Bureau of Plant Breeding,* suggested by the Lovat Committee (Cmd. 2825, para. 82—Appendix Paper 1),* and endorsed by the Colonial Office Conference.

iii. *Bureau of Soil Science,* suggested by the same authorities, and by the Board of Agriculture for Scotland (Appendix Paper 10),* by the Gold Coast (Appendix Paper 6 (*b*))* and by Ceylon (Appendix Paper 9a).*

iv. *Bureau of Plant Nutrition* (with special reference to Soil Science), suggested by Kenya (Appendix Paper 8).*

v. *Bureau of Animal Husbandry,* suggested by the Cambridge Animal Nutrition Institute.

vi. *Bureau of Dairy Research,* suggested by the National Institute for Research in Dairying.

vii. *Bureau of Agriculture,* or *of Tropical Agriculture,* suggested by the Gold Coast (Appendix Paper 6 (*a*))* and Nigeria.

viii. The question of a Publicity Bureau (suggested by India) is discussed in Agenda Memorandum 4.

ix. South Africa suggested the establishment of an Imperial Agricultural Research Committee with headquarters in London and corresponding members in the Dominions.

AGENDA : MEMORANDUM 4.

Interchange of Information.

This subject is intended to be confined to the interchange of information on the methods, progress, and results of agricultural research *between research and other officers concerned with agriculture* in different parts of the Empire. The question how the results can best be brought to the notice of the practical farmer raises another set of problems, of which the solutions must vary with the local conditions of each part of the Empire, must therefore be left primarily to the Government of that part, and do not seem to require any central organization with executive functions. Nor is it proposed that the present subject shall be taken to include interchange of information by personal contact ; the problems involved in this last matter are dealt with in separate documents on the interchange of workers and on the holding of periodical Conferences. The question is therefore narrowed down to the interchange of information through correspondence and publications.

(1) *The present position* as regards publications is as follows :—

(*a*) Papers by agricultural research workers, at all events in Great Britain, are published in many different technical journals as well as in journals and leaflets of the Departments of Agriculture, and in Annual Reports and separate Bulletins of Research Institutes.

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* See note at end of Appendix.

(*b*) The Ministry of Agriculture has made attempts to bring together in one volume the results of agricultural research work in this country ("Agricultural Research and the Land," by Mr. V. E. Wilkins, published by the Stationery Office) and it is intended to bring this volume up to date from time to time.

(*c*) The Ministry publishes a series of agricultural research monographs dealing with the work undertaken and in progress, in various branches of agricultural research in this country.

(*d*) An annual paper of the Agricultural Research Council sets out year by year lines and results of work and gives particulars of the papers published during the year by the various Research Institutes in Great Britain. This list is believed to be reasonably complete and would be suitable for despatch throughout the Empire (or to any central body which might be established) for the purpose of bringing Oversea workers in touch with the work done here. It may be added that on the proposal of Australia the Ministry has caused to be prepared for the information of the Conference abstracts of all papers published by research and advisory workers in Great Britain in the six months, October, 1926—March, 1927. These abstracts are printed as a separate Conference paper. It is proposed in future to amplify the Research Council paper in this way, which will add to its value for circulation throughout the Empire.

(*e*) Accounts of recent work and in some cases lists of publications have been supplied for the present Conference from Dominions and Colonies. These accounts have, for the most part, been incorporated in the Conference paper dealing with agricultural research in the Overseas Empire; reference to recent work will also be found in the Agenda Memoranda dealing with technical questions. The lists of publications are available for consultation if desired.

(*f*) There is an extensive interchange of publications dealing with agricultural research between Great Britain on the one hand, and the Dominions and the Colonies on the other, both by Government Departments and by Research Institutes. Particulars of this interchange are given in a Conference paper; but it is probably very incomplete, both as to the publications despatched and to those received.

(2) *Defects.*

There appear to be two obvious defects under the present arrangements:—

(*a*) Papers printed and published, particularly in the Dominions and Colonies, may not be known outside the place of origin, and may even be forgotten there within a few years.

(*b*) Occasionally a valuable piece of work may not be published at all, and in the absence of publication, either of a full paper or at least of a summary, may be entirely lost.

(3) *Suggestions for a remedy.*

(*a*) It is clearly necessary in the first place that there should be available periodically for each country a complete list of papers published by research workers and at least a summary of any unpublished work of importance. The arrangements for the preparation of these documents must obviously be left to the respective Departments of Agriculture. It might be well that the Departments should require workers to furnish short summaries of papers which they have published in order to give an idea of their contents and conclusions. This method would not be expensive: it would

ensure that the author's views were not misrepresented, and would involve little trouble for the research worker. In fact, the practice is now becoming common. The importance of an adequate Annual Report by each Department of Agriculture is stressed in a memorandum by Dr. E. J. Butler (Appendix Paper 4).*

(*b*) What is to happen to this list of papers and summaries when prepared ? It would, of course, be possible simply for each Government to send a copy or copies to the other constituent parts of the Empire ; but it seems clearly more convenient that there should be some central body or bodies to whom the list of papers and summaries should go from every part of the Empire and who would be charged with the duty of collecting, reviewing and circulating them.

(*c*) The question then arises whether there should be one central body or more than one for this purpose. In this connection it may be useful to state the present arrangements on this point. The Imperial Bureaux of Entomology and Mycology publish monthly journals containing abstracts of the work done in their respective branches of science. The Empire Cotton Corporation acts as a clearing house of information on cotton research within the Empire. The Lovat Committee has suggested that the Imperial Institute should deal with the subjects outside the purview of the two existing Imperial Bureaux. The Colonial Agricultural Research Service Organization Committee contemplates that one of the important matters falling to the proposed Colonial Agricultural Research Council will be the collection and publication of information where this is not already done by existing agencies (Appendix Paper 3).* The Government of India has suggested a special Publicity Bureau (Appendix Paper 5),* and the Union of South Africa the establishment of an Imperial Research Committee (Appendix Paper 6 (*b*)).*

The main arguments in favour of specialist Bureaux undertaking this work seem to be as follows :—

(1) On two important subjects, such Bureaux are already in existence and are doing the work with general acceptance.

(2) The Bureaux will have specialists competent to assess the merits of papers, and it might be urged that there will be duplication of staffs if similar specialists were attached to a separate Publicity Bureau.

(3) Specialist Bureaux can deal far more easily and directly than a general Publicity Bureau with the technical correspondence and enquiries which are likely to arise out of the publication and interchange work.

On the other hand it might be argued in favour of a single Publicity Bureau, that

(1) Agricultural Departments would need to send their lists and summaries to one body only, and not to several. Papers often bear on several different branches of research ; and a single Publicity Bureau would relieve the Departments from the task of deciding which was the most important subject in such cases ; or, in the alternative, of sending the lists and summaries to several Bureaux.

(2) Scientific workers and administrators are usually anxious for information on several branches of research, and therefore would need to be supplied with the publications of several Bureaux instead of one, if interchange through specialist Bureaux were adopted.

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* See note at end of Appendix.

(3) Concentration of the interchange and publication work under one body would *prima facie* mean economy in expenditure.

There is perhaps something to be said for a compromise, viz., that there should be one body to whom all the lists of papers and summaries would be sent; which body would distribute them again to the appropriate Bureau or Bureaux, sending, e.g., mainly mycological papers to the Imperial Bureau of Mycology. If this suggestion were adopted, the Imperial Institute or a special Committee working in close connection with it would seem to be an appropriate body to whom all papers should be sent in the first instance. Steps in this direction have been taken on the initiative of the Director of the Institute: the Dominions and Colonies have been asked whether they can arrange to send to the Institute every six months summaries of research work on raw materials. The Institute intends to publish this information in its Quarterly Bulletin (See Appendix Paper 1).*

In this Memorandum the question of the interchange of information by correspondence is not specifically touched. Workers will presumably communicate direct with each other on matters on which they find (as a result of seeing abstracts in Bulletins) that they would like further information. In this connection the list of Agricultural Research Workers within the Empire prepared for the present Conference may be of value. Nor does this Memorandum touch the question of the central body printing and publishing *in extenso* technical papers by research workers. Ordinarily such papers would be printed locally; but in exceptional cases a central body would no doubt be able to arrange for publication either in the journal of the appropriate specialist Bureau, if one existed, or in one of the unofficial technical journals, such as the Journal of Agricultural Science or the Journal of Pomology.

There are two further points. First, this Memorandum has not mentioned the question of papers and summaries by workers other than those engaged in agricultural research; although much matter bearing directly or indirectly on agriculture is published by workers in other sciences, e.g., Mathematics, Biology, Physics, Zoology, Engineering, and Economics. The sources of such matter are so numerous that if they were included, any scheme for the interchange of information might become unworkable and break down under its own weight. The same difficulty arises in regard to agricultural research work done outside the Empire, although the two Imperial Bureaux have been able to cope with all available published material whatever its source, dealing with entomology and mycology. It would perhaps be best to go step by step and to obtain satisfactory arrangements for research work within the Empire before attempting expansion in such directions: but, of course, the inclusion of agricultural research work of value done outside the Empire is important and its possibility ought not to be overlooked.

Lastly, it will be noted that discussion has been confined to interchange of information *on current work*. In course of time, however, an organization dealing with this subject will be able to supply references to past research. Until then it will presumably be necessary to refer enquirers to suitable indexes and bibliographies, and to indicate libraries where Bulletins, &c., can probably be consulted. In this connection attention may be drawn to the subject-matter index of the Science Library, South Kensington, attached to the Science Museum. A descriptive pamphlet of the Library is circulated separately to the Conference, and special arrangements have been made for a conducted visit by the Conference. The Empire Marketing Board are also assisting the compilation of information regarding the present state of knowledge in certain subjects of agricultural research.

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* See note at end of Appendix.

AGENDA : MEMORANDUM 5.

Periodical Conferences.

It may be useful to review briefly the position as regards conferences of agricultural research workers within the Empire. The general case for such conferences does not require to be set out ; but it might perhaps be suggested that they should as a rule aim rather at definite conclusions for common action. International conferences largely cover the ground so far as concerns simply the discussion of scientific questions from a purely scientific point of view, looking solely to the advancement of knowledge.

(*a*) *Conferences on Special Subjects.*

The bodies to whom the task should fall of calling conferences of specialists in agricultural research are obviously the Imperial Bureaux, either existing or to be created. The existing Imperial Bureaux of Entomology and Mycology already call conferences of Entomologists and Mycologists within the Empire quinquennially in London, through the Colonial Office. The last conference of the former was held in 1925 and of the latter in 1924.

The suggestion has been made by the South African Government (Appendix Paper 2)* that there should be triennial conferences in London of chemists of the Empire. This desire will probably be met by a recommendation for the creation of a Bureau of Soil Science, but if the Bureau is not created, the desired arrangements for such periodical conferences of chemists will presumably have to be made by some specially designated body or institution, e.g., Rothamsted.

A memorandum by Sir Arnold Theiler to the Colonial Office Conference 1927 (Appendix Paper 3 (*a*))* suggested the holding of congresses on animal diseases in the Empire at reasonably short intervals, say 3–5 years. As in the case immediately above, this suggestion will presumably be covered by a recommendation for the creation of an Imperial Veterinary Research Bureau, but if not, similar arrangements to those suggested for the chemists could be made.

The Lovat Committee suggested (Appendix Paper 1)* that there should be arrangements at intervals of 5 years for conferences of officials engaged overseas upon the subjects with which the clearing-house (see Agenda, Memorandum 4, on Interchange of Information) would deal. That Committee referred also to the opportunity provided by such conferences of examining the general policy and work of the Bureaux.

(*b*) *Conferences in Groups of Empire Countries.*

It is obviously desirable that conferences dealing with agricultural research in general should be held between Empire countries situated in similar climates and having similar problems, and, in fact, such conferences have already taken place, viz., in the West Indies, in South and East Africa and West Africa (Ibadan in Nigeria). The last-named conference is being continued biennially and arrangements have been made for as far ahead as 1933.

In a memorandum by the Parliamentary Under-Secretary of State for the Colonies to the Colonial Office, 1927 (Appendix Paper 3 (*b*))* it is pointed out that such conferences are of exceptional value, not only in themselves, but also by reason of the facilities they provide for workers in a similar field to discuss common problems informally and to see how these problems are being tackled under varying conditions. At the West African Conference also questions concerning agricultural development were referred by the Governments to the conference for discussion and advice (Appendix Paper 4).*

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* See note at end of Appendix.

The following grouping of countries is suggested by the Government of the Gold Coast for the purpose of such conferences (Appendix Paper 4)* :—

1. West Africa (Nigeria, Gold Coast, Sierra Leone, Gambia).
2. East Africa (Kenya, Tanganyika, Uganda, Nyasaland) (Zanzibar should possibly also be included).
3. West Indies.
4. Indian Ocean (Ceylon, Malaya, Mauritius, Seychelles).
5. Pacific (Queensland, Fiji).

and that Government also suggests further interchange of information, discussions, and decisions between these various groups.

The case for agricultural conferences in the tropical countries in the Empire is stated in the Gold Coast Memorandum.

Suggestions for the organization of such conferences are made by the Kenya Department of Agriculture (Appendix Paper 5).*

Where no arrangements are yet made for the calling of such conferences, it may be suggested that the initiative should lie either with one of the Governments concerned or with a Research Station. We may look forward to a chain of Research Stations, especially in tropical and sub-tropical parts of the Empire, each concerning itself with the problems of several countries. It will obviously be desirable for each such Station to call meetings of workers from the countries concerned.

(*c*) *Continuance of the present Conference.*

The whole question of the general arrangement for co-ordinating the various Governmental bodies concerned with research in this country is now under consideration : whatever form of organization here may be the outcome of that consideration, there seems to be some case for holding periodically (say once every five years) a conference intended primarily to review the working of the machinery for research all over the Empire, in such administrative and semi-administrative matters as those discussed at the present Conference. The completeness and efficiency of that machinery are of great importance to the whole of the Empire : and it can only be thoroughly surveyed and overhauled at a conference such as the present one.

If this view is taken, the questions would arise (*a*) when the next conference should be held, (*b*) where it should be held—perhaps like the Imperial Forestry Conference, in another part of the Empire, (*c*) who should call it and make the necessary arrangements—presumably the Government of that part of the Empire where it is held.

AGENDA : MEMORANDUM 6.

Unclassified Administrative Subjects.

(*See* Appendix C, p. 235.)

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* These appendices are not here reprinted ; for list of documents see Appendix C.

APPENDIX C.

LIST OF DOCUMENTS PREPARED FOR THE CONFERENCE AND LIST OF PAPERS SUBMITTED.

(i). Documents prepared.

(*a*) AGENDA: MEMORANDA.

1. Recruitment, Training and Interchange of Workers.
2. Proposed Chain of Tropical and Sub-Tropical Research Stations.
3. Imperial Bureaux.
4. Interchange of Information.
5. Periodical Conferences.
6. Unclassified Memoranda on Administrative Subjects.
7. Veterinary Science Papers.
8. Papers on Soils and Manures.
9. Papers on Plant Diseases and Pests.
10. Papers on Preservation and Transport of Agricultural Products.
11. Papers on Crops and Plant Breeding.
12. Papers on Animal Husbandry (including Pastures).
13. Papers on Agricultural Economics.
14. Dairying.
15. Other technical questions.

(*b*) OTHER PUBLICATIONS.

Agricultural Research in Great Britain and Northern Ireland.
Agricultural Research in the Overseas Empire.
Agricultural Research Workers in the Empire.
Abstracts of Papers on Agricultural Research in Great Britain.
Exchange of Publications between Great Britain and Northern Ireland and the Overseas Empire.
Card Index of the Science Library, Science Museum.
List of Objects in the Agricultural Machinery Section, Science Museum.
Pamphlet on the Exhibit of History of Agricultural Literature, British Museum.
Note on Westminster Hall.

(ii) List of Papers submitted to Conference.

AGENDA: MEMORANDUM 1.

Recruitment, Training and Interchange of Workers.

Memorandum submitted by Department of Agriculture, Union of South Africa.
Memorandum submitted by Department of Agriculture, Ceylon.
Memorandum submitted by Department of Agriculture, the Gold Coast.
Memorandum submitted by Department of Agriculture, Nyasaland.
Statement of facilities available in Great Britain for Overseas Veterinary Research Workers.

AGENDA: MEMORANDUM 2.

Proposed Chain of Tropical and Sub-Tropical Research Stations.

Australia, Memorandum: The proposed Queensland Tropical Agricultural Research Institute.

The Imperial College of Tropical Agriculture, Trinidad, B.W.I., by G. Evans, M.A., C.I.E.

Mauritius, Memorandum: Advantages for the extension of Sugar Research on an Imperial Basis in Mauritius.

Tanganyika, Memorandum: Development of Agricultural Research Institutions in Central Africa.

Nigeria, Memorandum: Agricultural Colleges and Central Research Institute.

AGENDA: MEMORANDUM 3.

Imperial Bureaux.

South Africa: Memorandum on Veterinary Science.

Gold Coast Memoranda:

(*a*) Establishment of an Imperial Bureau of Agriculture.

(*b*) Establishment of an Imperial Bureau of Soils.

Kenya, Memorandum: Imperial Bureau of Plant Nutrition.

Ceylon, Memoranda:

(*a*) The Establishment of a Bureau of Soil and Agricultural Chemistry.

(*b*) The Co-ordination of General Agriculture and Agronomy in the Tropics.

Madras: Memorandum.

AGENDA: MEMORANDUM 4.

Interchange of Information.

Imperial Institute Memorandum: The Imperial Institute as a Clearing House of Information.

Memorandum by Dr. E. J. Butler: Publication of Annual Reports.

India, Memorandum: The Desirability of Establishing a Publicity Bureau.

Union of South Africa, Memoranda:

(*a*) Publication of Scientific Papers;

(*b*) Establishment of an Imperial Research Committee.

Nigeria, Memorandum.

Gold Coast, Memorandum.

AGENDA: MEMORANDUM 5.

Periodical Conferences.

Union of South Africa, Memorandum: Desirability of arranging for conferences of official and officially recognized agricultural chemists of the Empire to be held triennially in London.

Gold Coast, Memorandum: Necessity for Organizing Regular Regional Agricultural Conferences.

Kenya, Memorandum: Organization of Agricultural Conferences.

Nigeria, Memorandum: Veterinary Conferences.

AGENDA: MEMORANDUM 6.

Unclassified Memoranda on Administrative Subjects.

New Zealand:—The advantages, from the administrative and research standpoint, of close co-operation between field workers engaged in instructional and investigational work, and laboratory research workers.

Tanganyika.

(*a*) Inter-relation of technical and executive workers for agriculture and means for co-operation.

(*b*) Place and limits of technical investigation within agricultural departments.

(*c*) Can a Tropical Agricultural College support itself?

South Africa:—Co-operation in Agricultural Research.

AGENDA : MEMORANDUM 7.

Veterinary Science Papers.

Tuberculosis Control and Research : Activities of the Dominion Department of Agriculture, Canada.

Animal Diseases in Australia.

Research in connection with certain Diseases of Dairy Cattle and Sheep in New Zealand.

India :

(*a*) The Present Position of Veterinary Research in India.

(*b*) Veterinary Research Problems in Madras.

(*c*) A Brief Outline of the Veterinary Conditions in the Punjab.

Foot and Mouth Disease and Osteoporosis of Horses in Ceylon.

Cyprus : Veterinary Notes.

Kenya :

(*a*) Veterinary Research and Problems in Kenya.

(*b*) Organization of Central Veterinary Research Laboratory.

Veterinary Problems in Nigeria.

Animal Diseases requiring Research in Nyasaland.

Sierra Leone : The Experimental Production of Immunity against Metazoan Parasites and an Investigation of its Nature.

Tanganyika : Trypanosomiases of Domestic Animals.

Department of Veterinary Pathology, University of Liverpool : Lamb Dysentery.

AGENDA : MEMORANDUM 8.

Papers on Soils and Manures.

Memorandum on a Proposed Soil Survey of those parts of Africa associated with the British Empire : Sir E. J. Russell.

Memorandum on a Proposed Soil Survey of those parts of Africa associated with the British Empire : Dr. F. J. Martin (Sierra Leone). (Supplementary to the Memorandum by Sir E. J. Russell.)

Nigeria : Memorandum on Soil Surveys.

Union of South Africa : Memorandum in reply to the Memorandum by Sir John Russell.

Nyasaland : Soil Survey.

Australia : Soil Studies.

Malaya : The Chemistry, Physics and Microbiology of Malayan Soils.

Barbados Soil Survey.

Ceylon : Memorandum on Soil Erosion.

Uganda : Soil Problems.

Union of South Africa :

(*a*) The Amelioration of Deteriorated Pineapple Soils.

(*b*) The Criteria which stamp waters and soils as unsuitable for irrigation purposes.

AGENDA : MEMORANDUM 9.

Papers on Plant Diseases and Pests.

Mycology :

Australia : Plant Disease Research.

New Zealand : Memorandum on Plant Pathology.

Union of South Africa : The Control of Plant Virus Diseases.

Trinidad and Tobago : Limes—Wither Tip and Resistant Varieties.

Entomology :

Canada : Memorandum regarding Research work carried on by the Entomological Branch, Dominion of Canada, Department of Agriculture.

Trinidad : Froghopper Investigation Committee : Investigations into the Froghopper Blight of Sugar Cane in Trinidad.

Barbados : Note on a Co-operative Scheme for Collection and Distribution of Parasites of Insect Pests. The Control of Insect Pests by Means of Parasites.

Helminthology :

Nyasaland : The Nematode Worm as a Major Pest of Tobacco.

AGENDA : MEMORANDUM 10.

Papers on Preservation and Transport of Agricultural Products.

Australia : The Preservation and Storage of Perishable Foods.
New Zealand : The Storage of Apples.
Union of South Africa :

(*a*) Lines of Investigation on Fruit Research and Transport in Dominions.
(*b*) Fundamental Investigations of General Interest that can be carried out in England.

AGENDA : MEMORANDUM 11.

Papers on Crops and Plant Breeding.

Imperial College of Tropical Agriculture, Trinidad : The Place of Genetics in Tropical Agricultural Research with Special Reference to Long Term Crops.
Ceylon : " Shifting " Cultivation.
New Zealand : The Testing of New Zealand Wheats.
Cyprus : Report on Cyprus Wheat.
Rothamsted Experimental Station : Lucerne.
Ceylon : The Effect of Grasses and Other Plants (e.g., leguminous cover crops) on Permanent Tropical Crops.
Gold Coast : Cocoa—problems requiring investigation.
Burma : Note on Burma Rice.
Barbados :

(*a*) Note on the Study of the Genetics of the Sugar Cane and the Correlation of Characters between the Earlier Stages and the Mature Stage of Seedling Sugar Canes.
(*b*) The Raising of New Seedling Cane Varieties in Barbados.

AGENDA : MEMORANDUM 12.

Papers on Animal Husbandry (including Pastures).

Cambridge : Animal Breeding, Growth and Rationing.
Australia :

(*a*) The Nutrition of Australian Animals of Economic Importance.
(*b*) The Improvement of Pastures in Relation to Mineral Deficiencies.
(*c*) Research on the Arid Flora of Australia.

New Zealand :

(*a*) Wool Research.
(*b*) Iron Starvation in Ruminants.
(*c*) Grassland Research.

Nyasaland : Subjects requiring Special Research in Relation to Animal Husbandry.

AGENDA : MEMORANDUM 13.

Papers on Agricultural Economics.

Union of South Africa : Investigation and publication of Customs Tariffs, Trade Agreements and Trade Restrictions affecting Commerce between Great Britain and the Dominions and between Dominions.
Tanganyika : Research in Economics for Tropical Countries.
Imperial College of Tropical Agriculture, Trinidad : Economics of Tropical Agriculture.

*Other Papers Submitted.**

Standardization of volumetric glassware used in testing Milk (Department of Scientific and Industrial Research).
British Methods of soil analysis. (Rothamsted Experimental Station.)
Cereal Rust Research (Experimental Farms Branch, Department of Agriculture, Canada).
(*a*) Soil erosion, (*b*) green manuring and use of fertilizers and (*c*) utilization of waste cellulosic materials (Southern Rhodesia).
Select methods for the examination of soils. (Draft of a Bulletin to be issued by the British Guiana Sugar Planters' Experiment Station.)
Memoranda from British Guiana on :—

1. Plan of a sugar estate on the coastland.
2. Diseases of sugar cane.
3. Sugar cane insects.
4. Rice.
5. Rice insects.
6. Coconuts.
7. Coconut diseases.
8. Coffee.
9. Bananas and Plantains.
10. Cacao.
11. Cacao disease.
12. Citrus.
13. Citrus diseases.
14. African Oil Palm.
15. Rubber.
16. Cotton.
17. Cotton diseases.

Note on shifting cultivation in the Gambia.
The Institute or Bureau of Soil Science (Kenya).
Memorandum on shifting cultivation in Sierra Leone.
Fruit (Trinidad and Tobago).
Root disease in the British West Indies and a note on *Diaporthe perniciosa* (Marchal) or a closely related species.
Soil analysis in the Sudan.

* Received too late for inclusion in classified Agenda Memoranda: submitted as unclassified papers.

APPENDIX D.

FULL PROGRAMME OF CONFERENCE (BUSINESS, SOCIAL AND TRAVELLING).

Grand Committee Room, Westminster Hall, Houses of Parliament.

Tuesday, October 4th, 1927.

Plenary Sessions.

Morning.—Conference formally opened by Lt.-Col. the Rt. Hon. Walter Guinness, D.S.O., M.P., Minister of Agriculture.

Appointment of the Rt. Hon. Lord Bledisloe, K.B.E., as Chairman, and the Lord Lovat, K.T., K.C.M.G., K.C.V.O., C.B., D.S.O., the Rt. Hon. W. Ormsby Gore, M.P., and Major Walter Elliot, M.C., M.P., as Vice-Chairmen.

Opening speech by Chairman.

Adoption of Rules of Procedure.

Discussion on Order of Business.

Appointment of Executive Committee.

Evening.—Dinner to Delegates in Royal Gallery, House of Lords. Minister of Agriculture in the Chair.

Wednesday, October 5th.

Plenary Sessions.

Morning.—Agenda Item 1. Recruitment, Training and Interchange of Workers (Agenda : Memorandum 1).

Afternoon.—Agenda Item 2. Proposed Chain of Tropical and Sub-Tropical Research Stations (Agenda : Memorandum 2).

Evening.—Visit to Science Museum, South Kensington, where a special exhibit on the history of agricultural implements had been arranged for the Conference.

Thursday, October 6th.

Plenary Sessions.

Morning.—Agenda Item 3. Imperial Bureaux (Agenda : Memorandum 3).

Afternoon.—Agenda Item 4. Interchange of Information (Agenda : Memorandum 4).

Friday, October 7th.

Plenary Sessions.

Morning.—Agenda Item 5. Periodical Conferences and Item 6—Other Questions of Organization (Agenda : Memoranda 5 and 6).

Afternoon.—Members of the Conference were shown over the Houses of Parliament.

Saturday, October 8th, until Thursday, October 13th.

Meetings of Administrative Commission and Specialist Committees in London.

Tuesday, October 11th.

Lunch at Mansion House by invitation of Lord Mayor of London.

In the afternoon by kind permission of the Lord Mayor the members were shown over the Guildhall.

Members of the Conference specially interested in agricultural economics were invited to tea at the house of the Horace Plunkett Foundation to meet Sir Horace Plunkett.

Evening.—Visit to British Museum, where an exhibit of agricultural literature dating back to Egyptian times had been arranged for the Conference. Lecture given by Mr. G. D. Amery, of the School of Rural Economy, Oxford.

Cambridge.

Friday, October 14th.

Inaugural luncheon in Trinity College Hall by invitation of the Vice-Chancellor (the Rev. G. A. Weekes, Master of Sidney-Sussex College.)

Afternoon.—Visit to the National Institute of Agricultural Botany.

Saturday, October 15th.

Morning.—Visit to Animal Nutrition Institute, Plant Breeding Institute and other branches of the Department of Agriculture and the School of Forestry.

Afternoon.—Visit to the University Farm.

Monday, October 17th.

Morning.—Visit to the Bio-Chemical Laboratory, the Low Temperature Research Station, and the Molteno Institute of Parasitology.

Afternoon.—Visit to the Balfour Institute of Genetics (Small Animal Breeding) and to the Department of Zoology (including Entomology).

Evening.—"At Home" in Gonville and Caius College by invitation of the Master and Fellows.

Tuesday, October 18th.

Morning.—Visit to the Institute of Animal Pathology and the Field Laboratories.

Billingham (Synthetic Nitrogen Works).

Tuesday, October 18th.

Evening.—Dinner given by Imperial Chemicals, Ltd., in their offices at Billingham.

Wednesday, October 19th.

Morning.—Inspection of Billingham works of Synthetic Ammonia and Nitrates, Ltd.

Edinburgh.

Wednesday, October 19th.

Evening.—Dinner given by Board of Agriculture for Scotland at the North British Station Hotel. Chairman of the Board of Agriculture for Scotland in the Chair.

Address by the Rt. Hon. the Earl of Balfour.

Thursday, October 20th.

Morning.—Visit to the Animal Breeding Research Department, Edinburgh University.

Lunch given by the University of Edinburgh in the Upper Library of the University.

Afternoon.—Visit to the Royal (Dick) Veterinary College and the Animal Diseases Research Station.

Evening.—Reception by Corporation of Edinburgh.

Friday, October 21st.

Morning.—Visit to the Plant Breeding Station and Plant Registration Station, Corstorphine.

Afternoon.—Visits to farm of East of Scotland College of Agriculture and to Holyrood Palace, Edinburgh Castle and other places of historical interest.

Aberdeen.

Saturday, October 22nd.

Morning.—Visit to the Rowett Research Institute and to the Soils and Drainage Department (University of Aberdeen), Craibstone.

Lunch given by Corporation of Aberdeen.

Afternoon.—Visit to the University of Aberdeen.

Belfast.

Saturday, October 22nd.

Morning.—Visit to Messrs. Gracey Bros.' cold store (grading and packing of eggs and cold storage facilities for eggs and dead poultry).

Visit to Hillhall (nr. Lisburn) (poultry fattening on an intensive and extensive scale).

Members specially interested in flax visited the Linen Research Institute at Lambeg and were entertained to lunch by the Association.

Afternoon.—Visit to the Plant Breeding Station, the Poultry Station, and the Animal Diseases Research Station at Stormont.

Evening.—Dinner given by the Government of Northern Ireland at the Grand Central Hotel. Minister of Agriculture for Northern Ireland in the Chair.

Address by the Prime Minister, the Rt. Hon. Lord Craigavon.

Sunday, October 23rd.

Morning.—Tour of the Ards Peninsula, Co. Down. The delegates were the guests of the Ministry of Agriculture for Northern Ireland at a lunch given at Donaghadee.

Grand Committee Room, Westminster Hall, Houses of Parliament.

Tuesday, October 25th.

Meeting of Administrative Commission to consider reports of Drafting Committees (1) and (2).

Evening.—Reception at the Imperial Institute by University of London and Ministry of Agriculture and Fisheries arranged by Imperial Institute.

Wednesday, October 26th.

Morning.—Meeting of Administrative Commission to consider report of Drafting Committee (3).

Lunch at Savoy Hotel given by the Rt. Hon. Sir Alfred Mond, Bt., M.P.

Afternoon.—Plenary Session to receive and consider report of Administrative Commission.

Thursday, October 27th.

Plenary Sessions to receive and consider reports of Specialist Committees.

Friday, October 28th.

Morning.—Concluding Plenary Session. Review of Conference work by Chairman.

Specialist Visits from October 29th onwards.

Saturday, October 29th.

Rothamsted Experimental Station.

Monday, October 31st.

Morning.—Imperial College of Science and Technology (Plant Physiology Research Institute), South Kensington.

Afternoon.—Royal Botanic Gardens, Kew.

Tuesday, November 1st.

East Malling Research Station.

Wednesday, November 2nd.

Oxford.

Morning.—Visits to the new Sugar Beet Factory at Eynsham, to demonstrations by the Institute of Agricultural Engineering and to the School of Rural Economy, the Agricultural Economics Research Institute, School of Forestry, and the Imperial Institute of Forestry.

Lunch at St. John's College (by kind permission of the President and Fellows) on the invitation of the Vice-Chancellor of the University.

Afternoon.—Visits to the Bodleian Library and Christ Church.

Tea in Christ Church Hall, on the invitation of the Dean, Canons and Students.

Thursday, November 3rd.

Ministry of Agriculture and Fisheries Veterinary Laboratory, New Haw, Weybridge, and the Foot-and-Mouth Disease Research Station at Pirbright.

The Royal Horticultural Society's Gardens, Wisley, and the John Innes Horticultural Institution, Merton, Surrey.

The Imperial Bureau of Entomology Parasite Laboratory, Farnham Royal, Bucks.

The Forest Products Research Laboratory, Princes Risborough.

Friday, November 4th.

The Institute of Animal Pathology, Royal Veterinary College, Great College Street, Camden Town, N.W.

The Fruit Research Station at Long Ashton, nr. Bristol.

Saturday, November 5th.

The Institute of Agricultural Parasitology, St. Albans.

The National Institute for Research in Dairying, Shinfield, nr. Reading. The University of Reading was also visited. The members were entertained to lunch by the University.

The Glasshouse Crops Research Station, Waltham Cross.

Monday, November 7th.

Wye Agricultural College. The members were entertained to lunch by the College.

Bangor and Aberystwyth.

Monday, November 7th.

Afternoon.—Visit to University College of North Wales, Memorial Buildings, Bangor.

Tuesday, November 8th.

Morning.—Visit to laboratories at University College and inspection of soil profiles (hill grazings).

Afternoon.—Visit to College Farm and inspection of soil profiles (lowland).

Evening.—Informal reception by University College.

Wednesday, November 9th.

Afternoon.—Visit to Welsh Plant Breeding Station, Aberystwyth (laboratories).

Evening.—Dinner given by the Principal of the University College of Wales.

Thursday, November 10th.

Morning.—Visit to Welsh Plant Breeding Station Farm and Gardens.

APPENDIX E.

(See Report, paragraph 9.)

I.

Minute of the relations agreed upon between the Ministry of Health (an administrative Department) and the Medical Research Council (a body initiating and fostering long-range research) for the delimitation of their respective functions.

Ministry of Health.	*Medical Research Council.*
1. To survey existing knowledge with a view to its applications or applicability to practical uses.	1. To survey existing knowledge with a view to right direction of new research efforts.
2. To survey by statistical or other means existing states of national (and international) health and environment, both absolutely and in relation to past history.	2. Medical research by statistical methods (primarily for the development of new methods of statistical inquiry).
3. To provide investigation (by use of existing knowledge and recognized methods) of scientific problems arising in the current administrative work of the Ministry.	3. To give assistance to current medical research investigations, whether pathological, biochemical or other kinds (including studies made into the better standardization of materials or methods).
4. To initiate research by reference to the M.R.C. or by encouraging local authorities or other agencies to direct and carry it out, and to initiate and themselves to direct research by such investigations as can best be carried out by the Ministry, in the interests of public health administration, applied knowledge or medical services.	4. To promote new knowledge by the initiation and organization of research in the medical sciences.
5. To propagate the results gained under all the foregoing heads by publication, by suitable information to local authorities or to the general public, and in general to promote the applications of the results in practical life, whether in the Ministry or outside it.	5. The publication of the results of research work in such a form as to aid research workers in general and to secure available application.

II.

Extracts from the resolutions of the Agricultural Conference held in Melbourne in March, 1927, between representatives of the Commonwealth Council for Scientific and Industrial Research and the State Departments of Agriculture and Research Organizations :—

* * * * *

2. The field for the investigation of agricultural problems is almost unlimited in scope. In this field there are many problems which are regional or national in range or scope, fundamental in character, and which require concentration of effort and highly specialized research for their solution. These problems are specially suited for investigation by the Commonwealth.

3. The research problems confronting the agricultural and livestock industries may be classified broadly into three categories :—

(i) Investigation of the principles governing the practice of farming and the rearing and feeding of stock.

(ii) The production of new varieties or breeds of plants or animals.

(iii) The investigation of diseases of plants and animals with a view to control.

I. *Investigation of principles underlying the practice of agriculture and livestock husbandry.*—This group of problems covers an exceedingly wide

range, namely, soil problems, plant biology, production of farm crops, introduction of new plants and animals, plant nutrition (including improvement of pastures), dairying, horticulture, apiculture, animal nutrition and agricultural economics.

Investigations in this field which are of a more or less fundamental character and which are national in scope should be conducted by the Commonwealth, whilst problems of a more or less local character and which involve the application of existing knowledge should be undertaken by the State Departments of Agriculture.

II. *Production of new varieties or breeds of plants and animals.*

(i) *Plants.*—Much valuable work has been accomplished by various State Departments of Agriculture, and many new and valuable varieties of wheat have been produced which have already led to a considerable increase in wheat production.

This work should be encouraged and extended to include other farm crops which have not been subjects to such intensive work.

Two distinct types of problems are involved :—

(a) *Plant Genetics.*—An investigation of the botanical, morphological, and other characters of plants grown in Australia, and an investigation of the genetic factors involved in disease resistance.

(b) *Plant Breeding.*—The application of scientific principles to the systematic improvement of existing varieties.

The former group of problems (Plant Genetics) should be carried out by the Commonwealth. The latter (Plant Breeding) should be carried out by existing organizations.

(ii) *Animals.*—A somewhat similar division of problems may be made regarding animals :—

Animal Genetics.—The genetic analysis of the economic characters of livestock, including the meat quality and milk yield of cattle, wool quality and yield of wool, and carcase of sheep, egg and meat quality and yield of poultry, and the like constitute a group of research problems which are of national importance and require highly specialized research for their solution, and form an appropriate field for Commonwealth investigation.

Animal Breeding.—The application of existing knowledge of principles to the breeding and improvement of farm animals. This field of work should be left to existing State Departments of Agriculture.

III. *Disease and its Control.*—The field work in connection with diseases in plants and animals is vast, and must increase with the intensification of production.

Plant Diseases : *Plant Pathology and Entomology.*—The problems associated with disease in plants may be divided broadly into two fields :—

(i) Investigation of the life-history of the causal organism, the mode of infection and conditions of attack with a view to suggesting control measures.

(ii) The application of known principles to the elimination of insect, fungus or other pests within definite regions. The former problems are specially suited for Commonwealth investigation while the latter should be carried out by the State Institutions.

Animal Diseases.—Investigation of work on animal diseases might be regarded as within the sphere of the Commonwealth, and they should be conducted in association with the States as regards field work.

IV. The Council for Scientific and Industrial Research could render a service to the Agricultural Institutions for the Commonwealth by acting as a clearing-house for information on research projects in progress in State Institutions and Universities. The State should supply information on research projects in hand or contemplated, and the Commonwealth should supply the States with similar information regarding its projects in agricultural research.

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